APPENDIX B

California Class 1 Area Visibility Descriptions

TRIN1 Monitor

The TRIN1 monitor location represents two wilderness areas located in the Marble and Klamath Mountains in Northern California. The wilderness areas associated with the TRIN1 monitor are Marble Mountain and Yolla-Bolly Middle Eel Wilderness Areas. The TRIN1 site has been operating since July 2000. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2000.

Section I. TRIN1 Wilderness Area Descriptions

I.a. Marble Mountain Wilderness Area

The Marble Mountain Wilderness Area (Marble Mountain) consists of about 200,000 acres of the Marble Mountains of northern California. Its northern boundary is about 25 miles south of the Oregon/California border. Its principal drainage is Wooley Creek that flows westward into the Salmon River drainage and Pacific Ocean via the Klamath River. Terrain is forested mountains, with highest elevations 2,103 meters to 2,195 meters. The lowest elevation is about 198 meters on the western boundary where Wooley Creek exits the Wilderness.

Figure 1. Marble Mountain Wilderness area

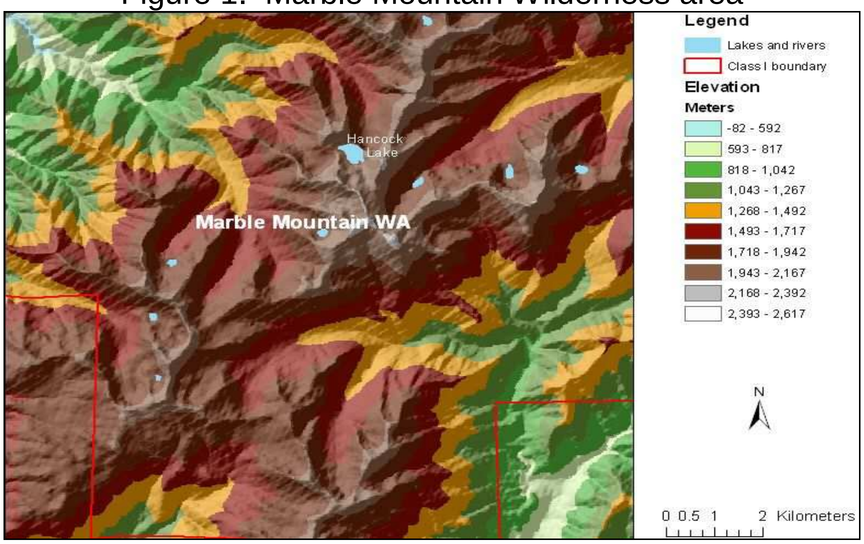


Figure 2. WINHAZE image of Marble Mountain Wilderness Area (3.4 vs. 17.4 dv)

I.b. Yolla-Bolly Middle Eel Wilderness Area

The Yolla Bolly – Middle Eel Wilderness Area (Yolla Bolly) lies on about 150,000 acres in the Klamath Mountains region near the southern extent of the Cascade Range in northern California. The wilderness is just west of the north end of the Sacramento Valley near Redding. On the west side the Wilderness the North and Middle Forks of the Eel River flow west into the Pacific Ocean near Redwood National Park. On the east side the South Fork of Cottonwood Creek flows to the northern Sacramento Valley between Redding and Red Bluff. The lowest elevation, about 792 meters, is on the eastern boundary where Cottonwood Creek exits the Wilderness, about 610 meters above the northern Sacramento Valley floor at Redding. The highest elevation is 2,467 meters at the peak of Mt Linn.

Figure 3. Yolla Bolly – Middle Eel Wilderness area

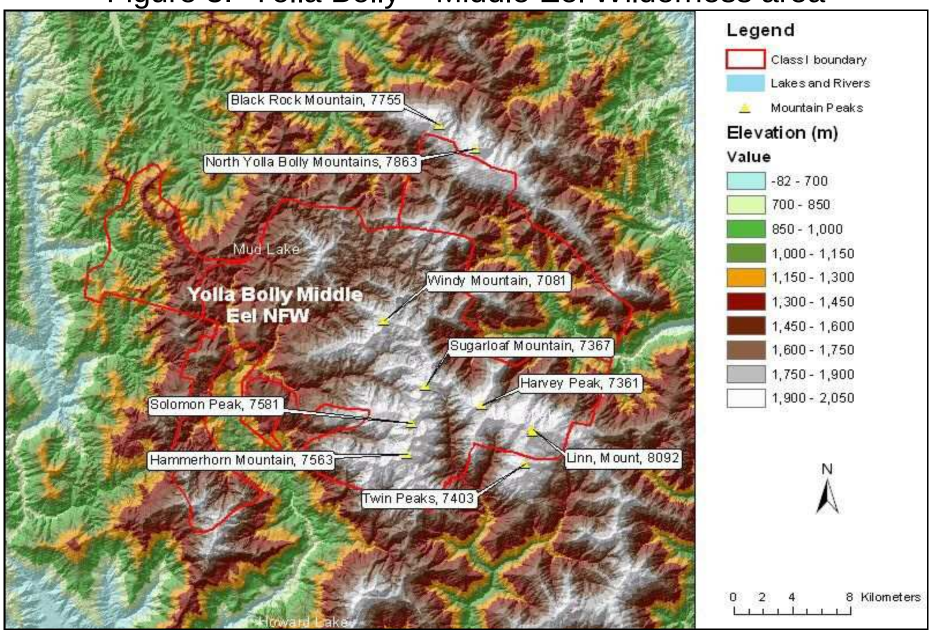


Figure 4. WINHAZE image of Yolla Bolly Wilderness Area (3.4 vs. 17.4 dv)

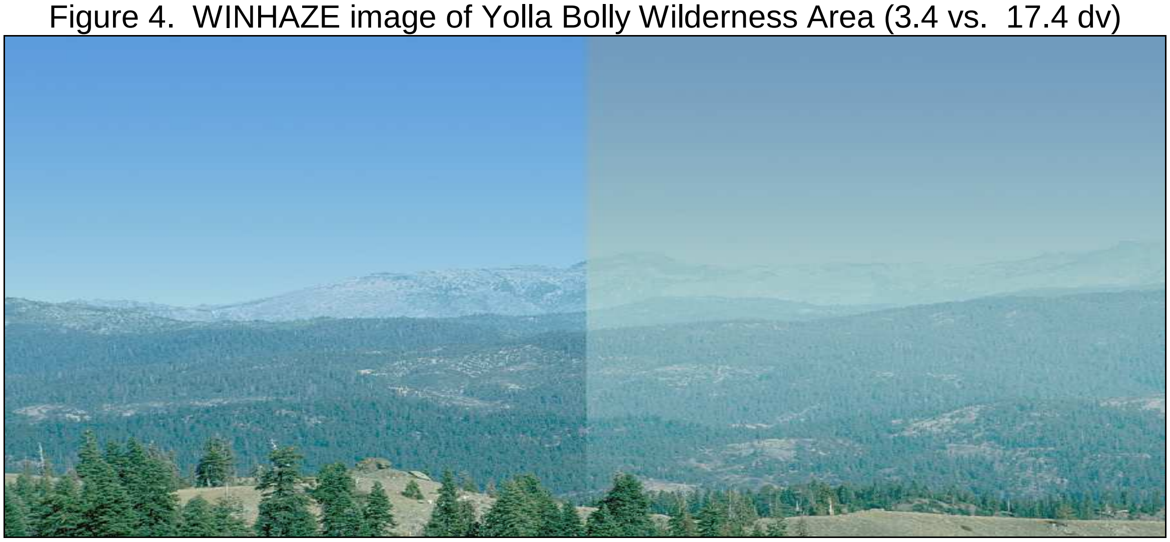


Figure 5. TRIN1 Monitor location in California

Section II. Visibility Conditions:

II.a. Marble Mountain Wilderness Area

Visibility conditions for Marble Mountain are currently monitored by the TRIN1 IMPROVE monitor in the Trinity Alps. The monitor is located at 40.7864 north latitude and 122.8046 west longitude, located midway between the Marble Mountain Wilderness Area and the Yolla Bolly – Middle Eel Wilderness Area in the Trinity Alps. TRIN1 is situated on a ridge crest of Pettijohn Mountain at an elevation of 1,014 meters. It is about 40 miles southeast of the Marble Mountain Wilderness, in the Trinity River drainage, with an intervening 1,798 to 1,981 meter crest line.

The monitoring location, TRIN1, may not be influenced by the same local sources that impact the Marble Mountain Wilderness because of the distance and intervening terrain. In particular, it may be more subject to Sacramento Valley emissions than the Marble Mountain Wilderness. It should be representative of aerosol characteristics in the Marble Mountain during periods of more uniform regional haze resulting from regional forest fire events or transport from more distant source regions on a global scale. The closest source region with anthropogenic emissions that may contribute to aerosol and haze at the TRIN1 site is the Sacramento Valley. The communities of Redding and Red Bluff are about 25 miles southeast of the site. The Sacramento Valley may provide a link between TRIN1 aerosol measurements and emissions from the larger Sacramento and San Francisco Bay areas during low level southerly flow. Marble Mountain is more distant, about 40 miles northwest of TRIN1 and 50 to 60 miles from the northern Sacramento Valley.

The TRINI location is adequate for assessing the 2018 reasonable progress goals for the Marble Mountain Wilderness Class 1 area.

II.b. Yolla-Bolly Middle Eel Wilderness Area

Visibility conditions for the Yolla Bolly – Middle Eel Wilderness are currently monitored by the TRIN1 IMPROVE monitor in the upper Trinity River valley. The monitor is located at 40.7864 north latitude and 122.8046 west longitude midway between the Marble Mountain Wilderness Area and the Yolla Bolly – Middle Eel Wilderness Area in the upper Trinity River valley. TRIN1 is situated on a ridgecrest of Pettijohn Mountain at an elevation of 1,014 meters. It is 40 to 50 miles north of Yolla Bolly – Middle Eel Wilderness. Also, it is within the Trinity River valley and separated from the northern Sacramento Valley by the intervening Trinity Mountains crestline with elevations of 2,820 meters and higher.

TRIN1 is probably not influenced by local transport from the Sacramento Valley to the same extent as Yolla Bolly when Valley emissions are transported across the Trinity Range during southerly flow conditions. It should be representative of aerosol characteristics at Yolla Bolly during periods of more uniform regional haze, resulting from regional forest fire events or transport from more distant source regions on a global scale. The Sacramento Valley is the closest source region with emissions that may contribute to haze in the Yolla Bolly. Sacramento Valley may provide a link to emissions from the larger Sacramento and San Francisco Bay areas during low level southerly flow.

The TRIN1 location is adequate for assessing the 2018 reasonable progress goals for the Yolla Bolly – Middle Eel Wilderness Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from TRIN1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the TRIN1 monitor is calculated at 3.4 deciviews for the 20% best days and 17.4 deciviews for the 20% worst days. Figure 6 represents the worst baseline visibility conditions.

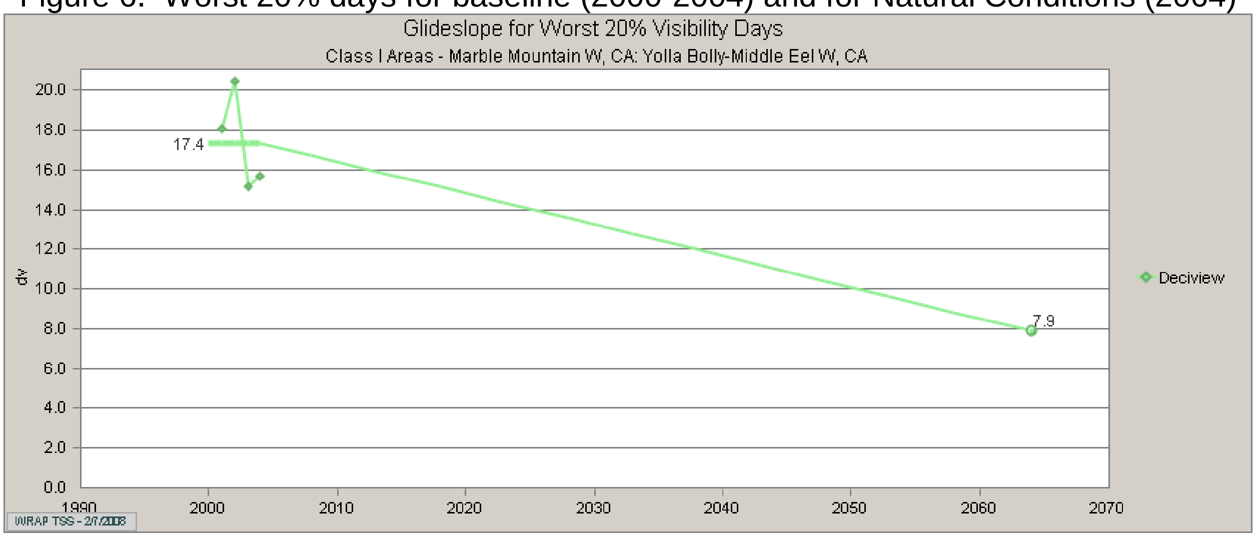
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the TRIN1 monitor is 1.2 deciviews for the 20% best days and 7.9 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 6 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 15.15 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 3.4 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 6. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at TRIN1.

Figure 7. Average Haze species contributions to light extinction in the baseline years

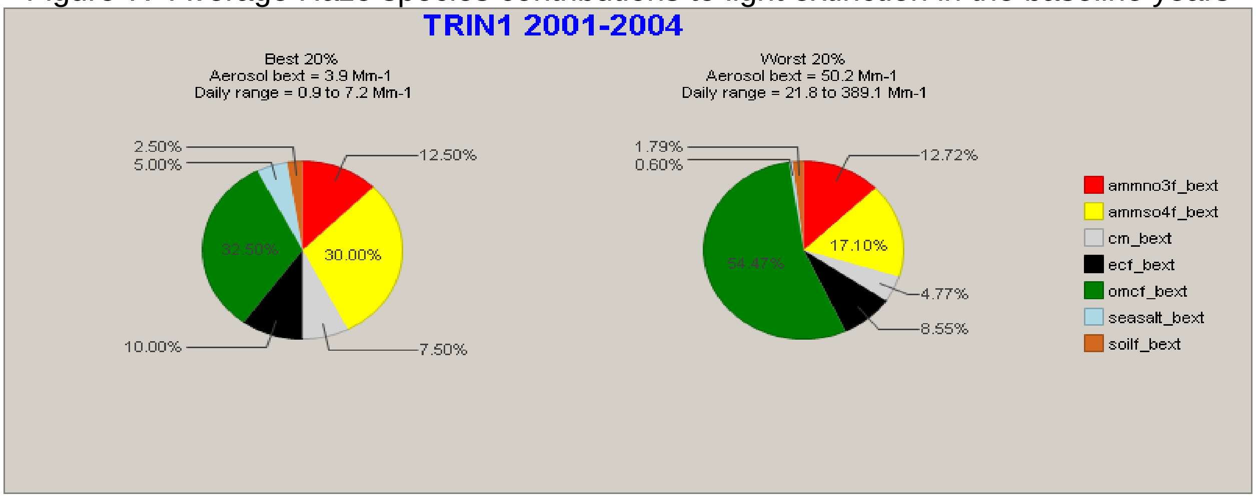
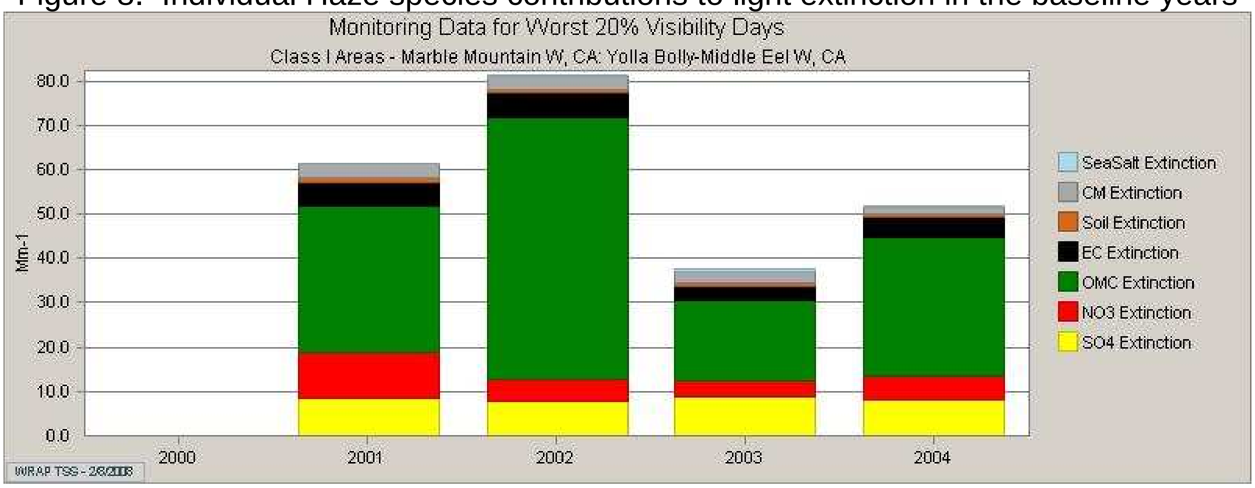


Figure 8. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 7 and 8, organic matter, sulfates, and nitrates have the strongest contributions to degrading visibility on worst days at the TRIN1 monitor. Organic matter dominates both the best and worst days at the TRIN1 monitor.

Figure 9 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and early spring while sulfates increase slightly in the summer months. Organic matter remains high throughout the summer. Organic matter clearly dominates the other haze species on worst days, but nitrates, sulfates, coarse mass and elemental carbon also contribute to the worst days in the summer. There are only trace amounts of sea salt and soil present throughout the years.

Figure 10 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparative to Figure 9 for organic matter, nitrates, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 9. Species contribution on the 20% worst days in 2002

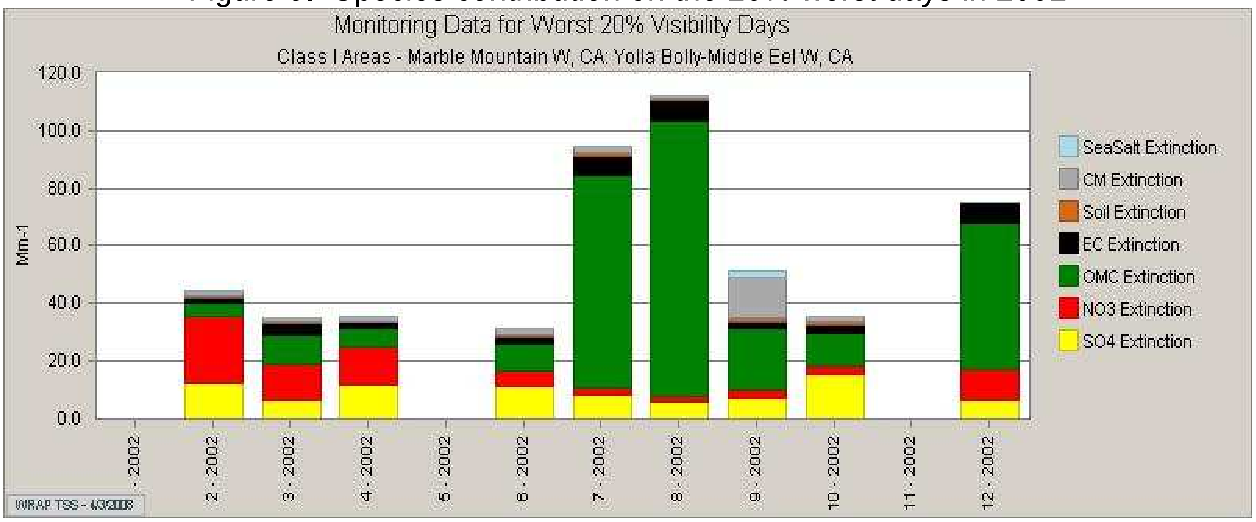
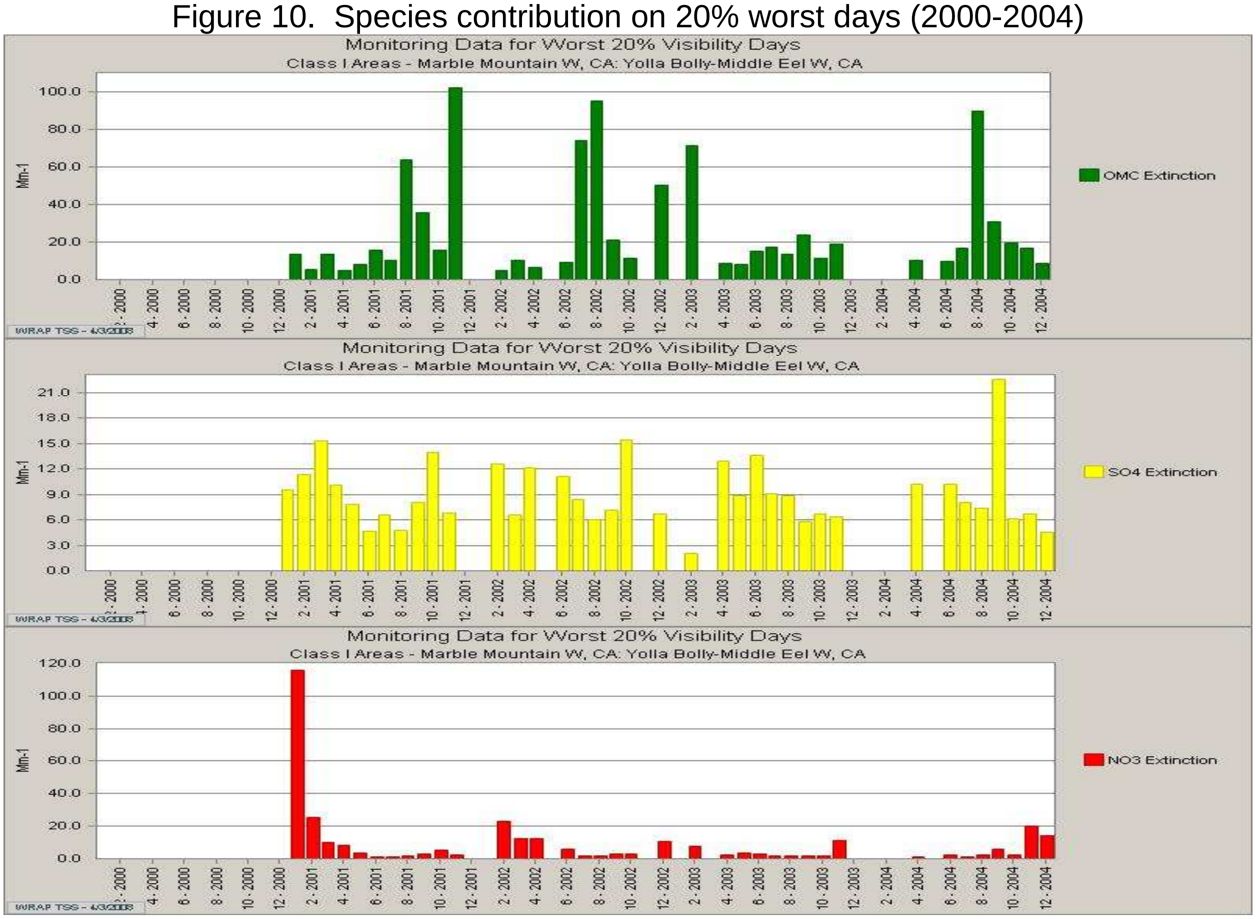


Figure 10. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at TRIN1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 11 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the TRIN1 monitor is from natural fire sources within Oregon. Oregon represents 67% of all natural fire source contributions.

Figure 12 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 62% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 36% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 13 and 14 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at TRIN1. The WRAP region represents 41% of the sulfate contributions in 2002 and 2018, followed by the emissions from the Outside Domain Region (38%) and the Pacific Offshore Region (17%). California contributes 15% of the total sulfate emissions seen at the TRIN1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the TRIN1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore Region.

Figures 15 and 16 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (80%), followed by the Outside Domain Region (13%) and emissions from Pacific Offshore (5%). Mobile sources within California contribute the most nitrate at the TRIN1 monitor. In 2002, California accounted for 81% of all mobile sources. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 11. Organic carbon source contribution from CA and outside regions

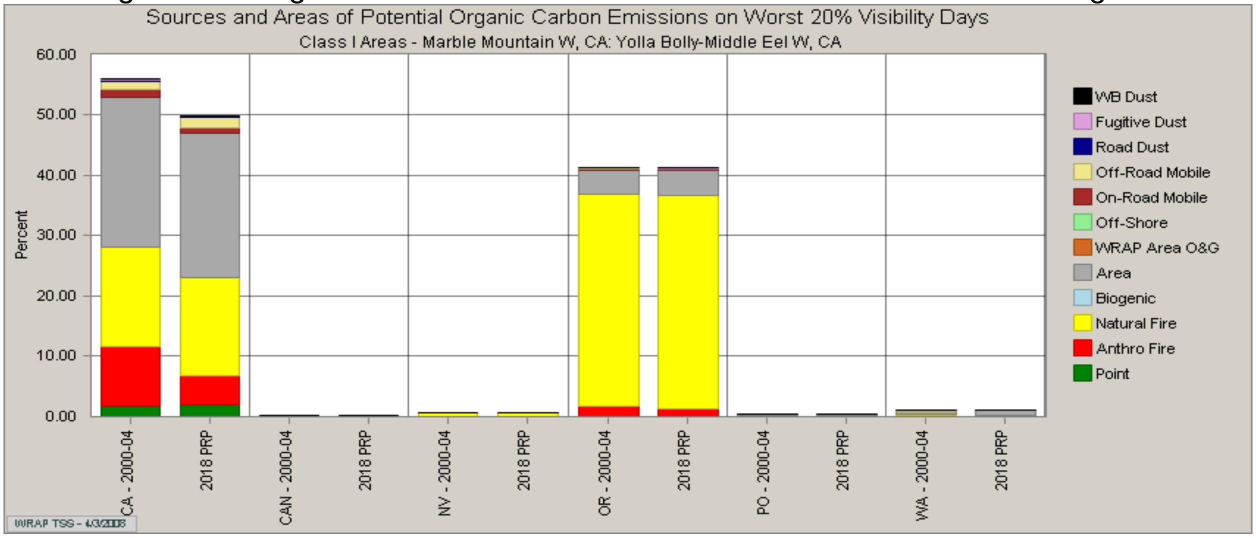


Figure 12. Organic carbon Anthropogenic and Biogenic Source Apportionment

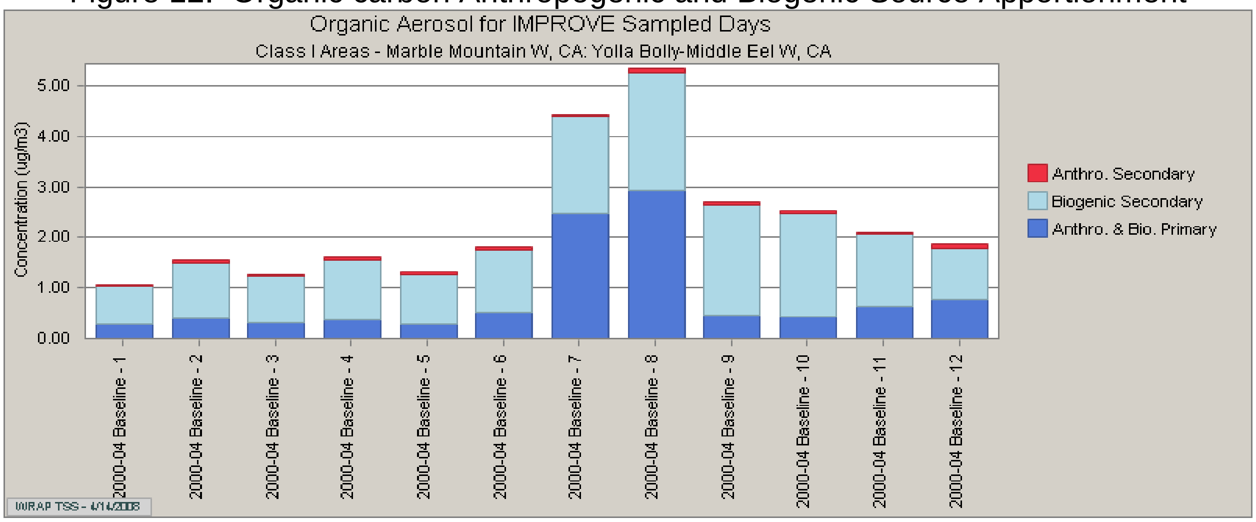


Figure 13. Regional Sulfate Contribution to Haze in 2002 and 2018

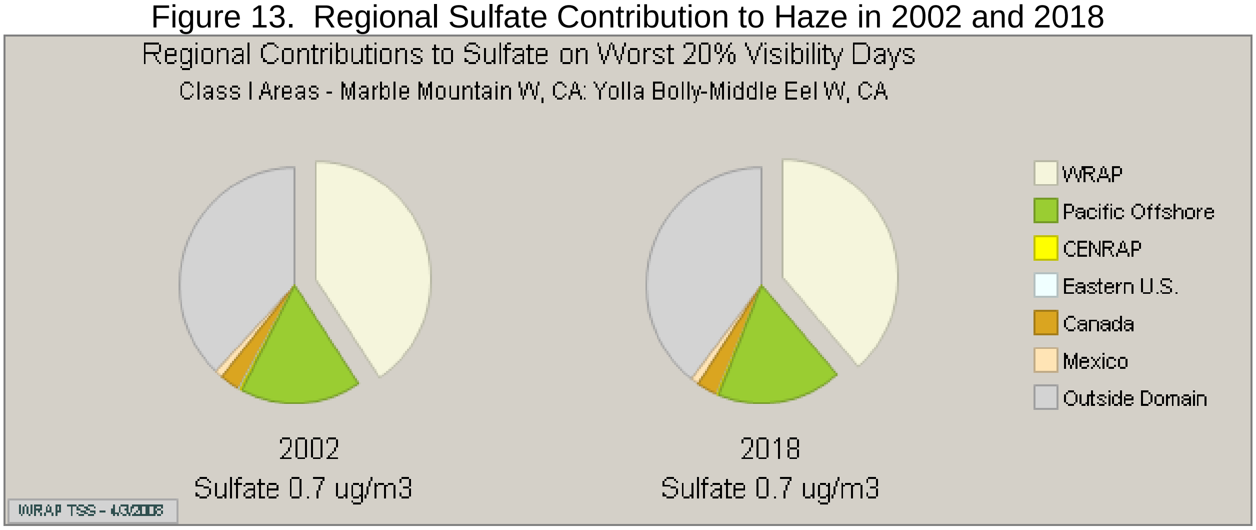


Figure 14. Sulfate source contribution from CA and outside regions

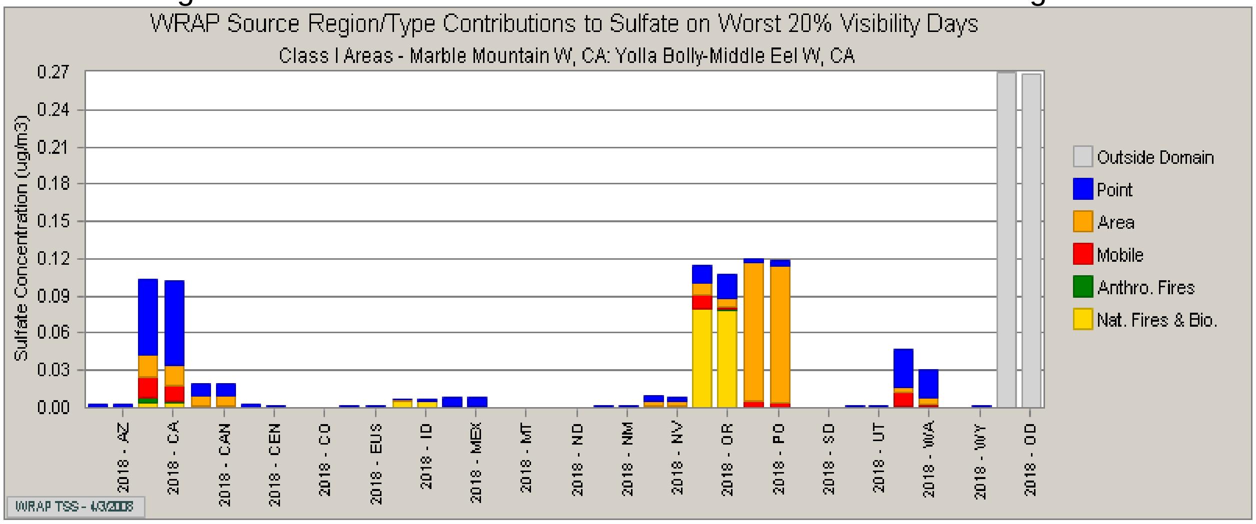


Figure 15. Regional Nitrate contribution to Haze in 2002 and 2018

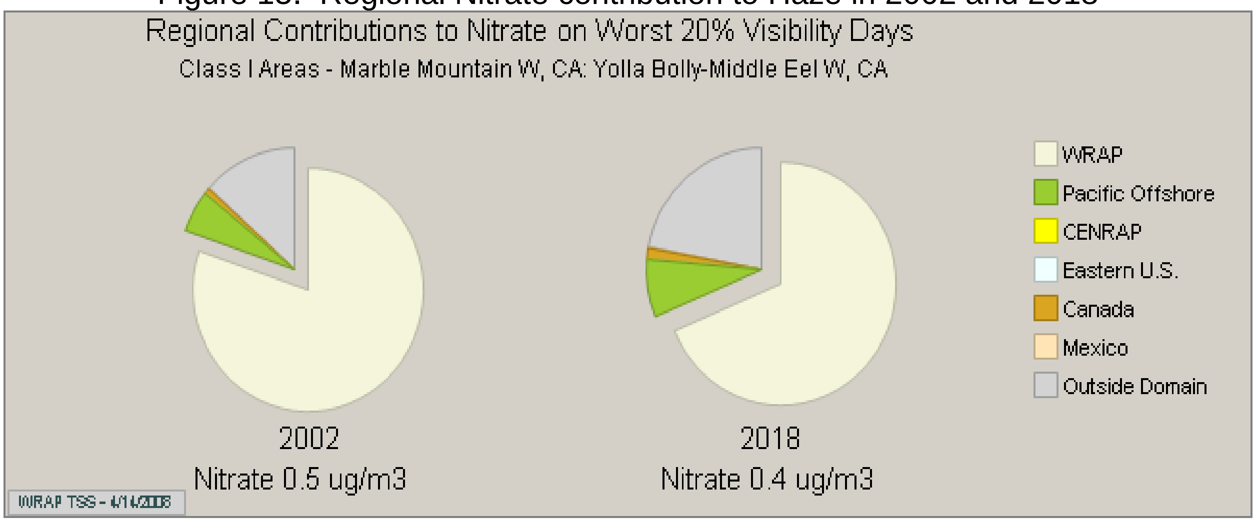
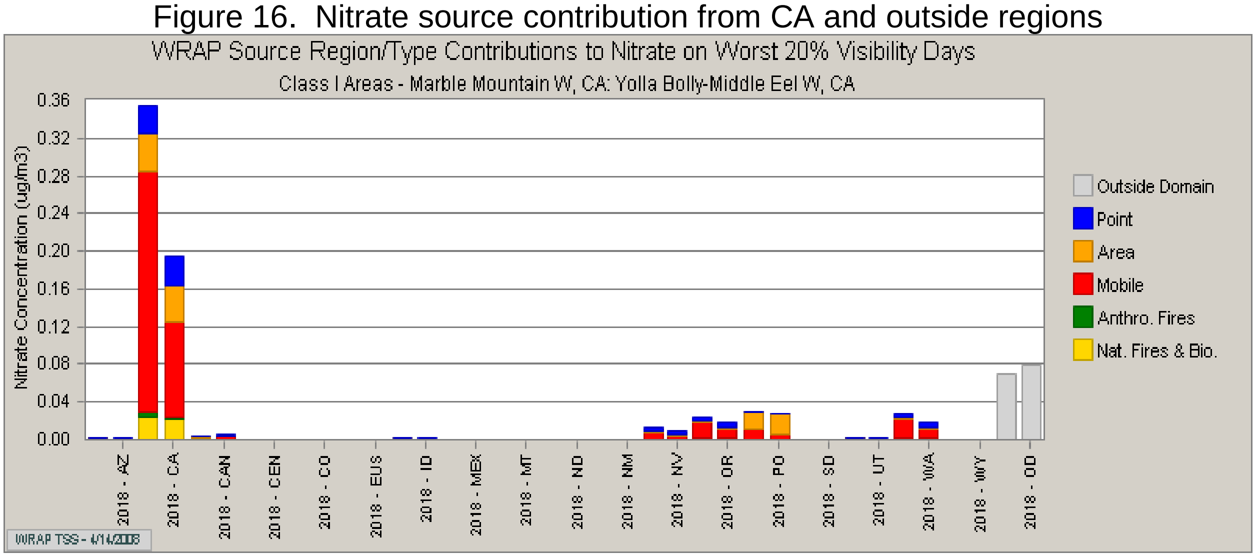


Figure 16. Nitrate source contribution from CA and outside regions



LABE1 Monitor

The LABE1 monitor location represents two wilderness areas located within Siskiyou and Modoc Counties. The wilderness areas associated with the LABE1 monitor are Lava Beds Wilderness area and South Warner Wilderness area. The LABE1 site has been operating since March 2000. This site does not have sufficient data for the entire baseline period. Data was not available for year 2000.

Section I. LABE1 Wilderness Area Descriptions

I.a. Lava Beds Wilderness Area

The Lava Beds Wilderness Area (Lava Beds) consists of 28,460 acres in the Lava Beds National Monument in northeastern California, bordering the eastern slopes of the Sierra Nevada range, 43 miles northeast of Mt. Shasta. Lava Beds terrain is flat, gently sloping upwards towards the southwest. Elevations range from about 1,219 meters to 1,737 meters.

Figure 1. LABE1 Monitor location

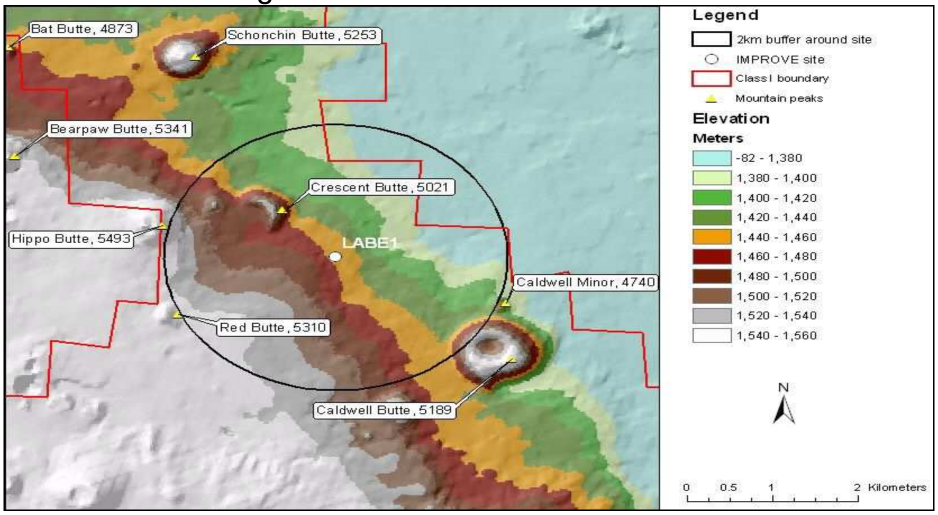
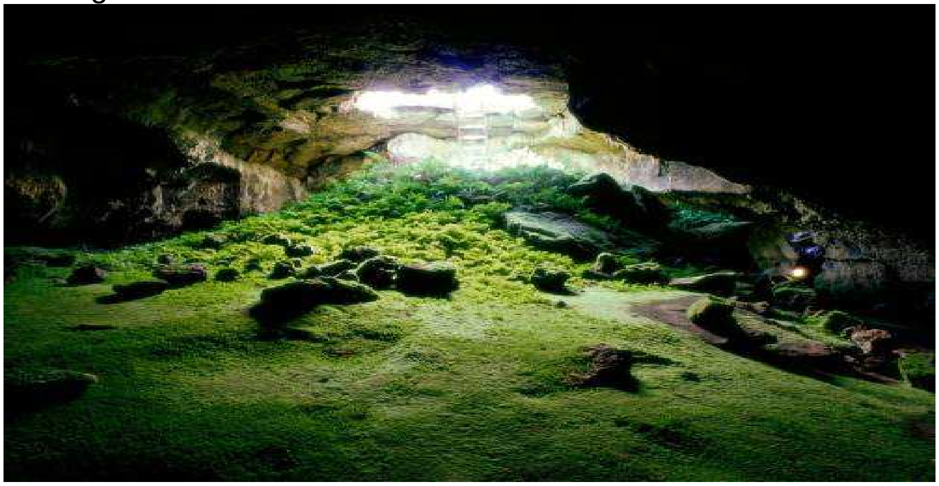


Figure 2. Lava Tube cave at Lava Beds Wilderness Area



I.b. South Warner Wilderness Area

The South Warner Wilderness consists of 70,385 acres on the Warner Mountain Range, an isolated spur of the Cascade Range in extreme northeastern California. Elevations range from about 1,600 meters along the eastern Wilderness Boundary to 3,015 meters at the crest of Eagle Peak. The terrain is gently rolling on the western slopes, with steeper eastern slopes.

Figure 3. South Warner Wilderness Area

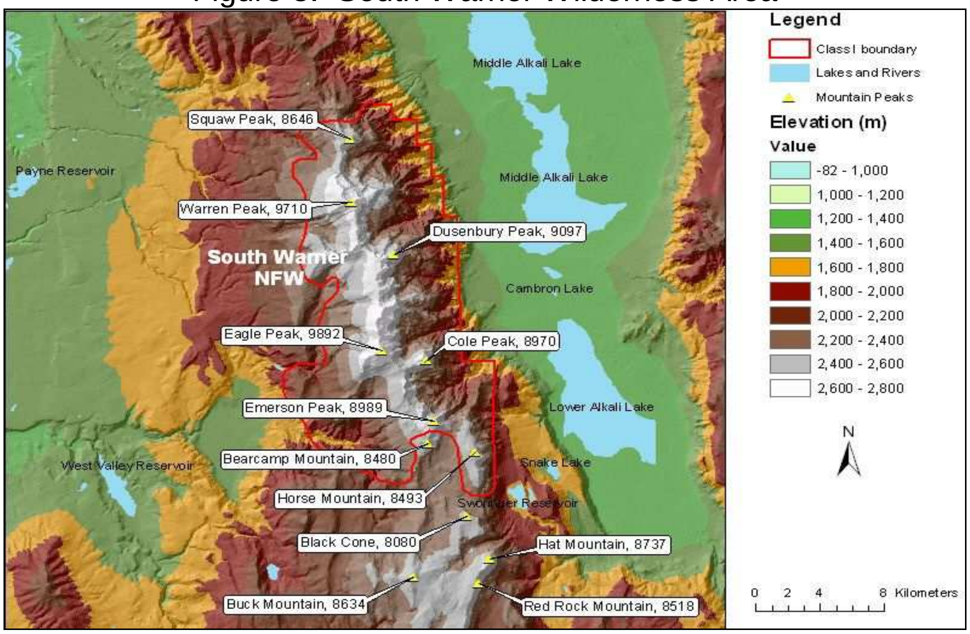


Figure 4. South Warner Wilderness Area

Figure 5. LABE1 Monitor location in California

Section II. Visibility Conditions:

II.a. Lava Beds Wilderness Area

Visibility conditions for Lava Beds are currently monitored by the LABE1 IMPROVE monitor. The monitor is located at 41.7117 north latitude and 121.5068 west longitude, located near the southern end of Lava Beds Wilderness at an elevation of 1,460 meters.

Lava Beds is located at the northwestern fringe of the Great Basin physiographic region. The nearest population area and potential source region is the northern Sacramento Valley to the southwest, separated from the Lava Beds and South Warner Wilderness areas by the northern Sierra Nevada and southern Cascade Ranges. High aerosol concentrations at LABE1 may result from regional forest fires. Entrained crustal material from exposed desert surfaces may be a source of particulate matter during strong wind episodes. At times during the extended summer a significant southerly component of flow from the Sacramento Valley could bring lofted emissions to the area over relatively low lying terrain between the southern Cascade Range and northern Sierra Nevada Range. Worst haze conditions at LABE1 may result from regional forest fires during regional stagnation episodes.

The LABEI location is adequate for assessing the 2018 reasonable progress goals for the Lava Beds Wilderness Class 1 area.

II.b. South Warner Wilderness Area

Visibility conditions for the South Warner Wilderness are currently monitored by the LABE1 IMPROVE monitor located near the southern end of Lava Beds Wilderness. The monitor is located at 41.7117 north latitude, 121.5068 west longitude, at an elevation of 1,460 meters, 70 miles northwest of the South Warner Wilderness Area.

The LABE1 IMPROVE site should be representative of the South Warner Wilderness Area during regionally homogeneous atmospheric conditions that prevail during worst haze conditions in this isolated area of northeastern California. The nearest population area and potential source region, with respect to the LABE1 IMPROVE site, is the northern Sacramento Valley to the southwest, separated from the South Warner Wilderness by the northern Sierra Nevada and southern Cascade Ranges. High aerosol concentrations at LABE1 may result from regional forest fires. Entrained crustal material from exposed desert surfaces may be a source of particulate matter during strong wind episodes.

The LABE1 location is adequate for assessing the 2018 reasonable progress goals for the South Warner Wilderness Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from LABE1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the LABE1 monitor is calculated at 3.2 deciviews for the 20% best days and 15.1 deciviews for the 20% worst days. Figure 6 represents the worst baseline visibility conditions.

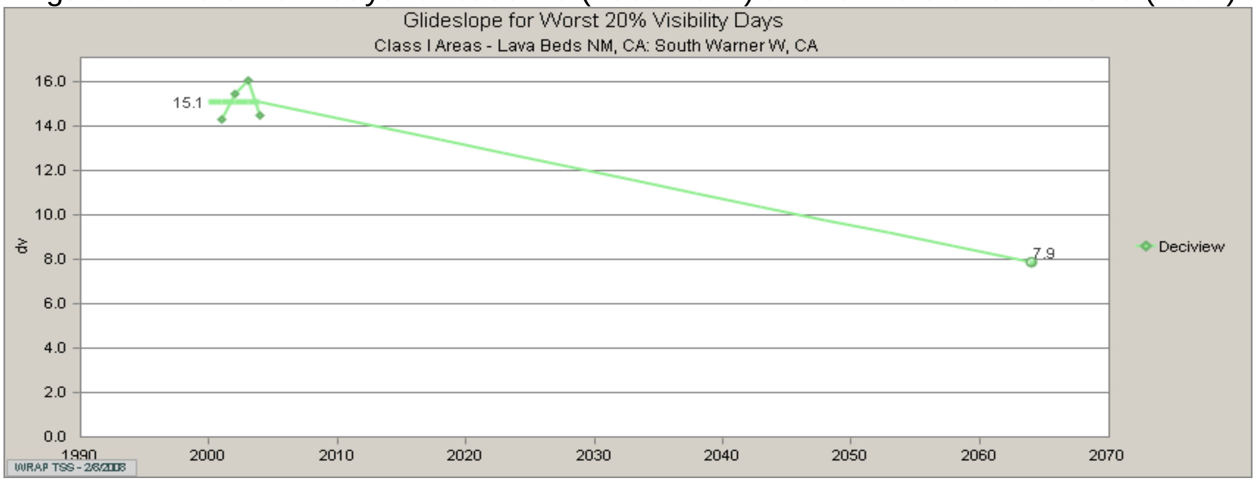
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the LABE1 monitor is 1.3 deciviews for the 20% best days and 7.9 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 6 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 13.37 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 3.2 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 6. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 7 shows the contribution of each species to the 20% best and worst days in the baseline years at LABE1.

Figure 7. Average Haze species contributions to light extinction in the baseline years

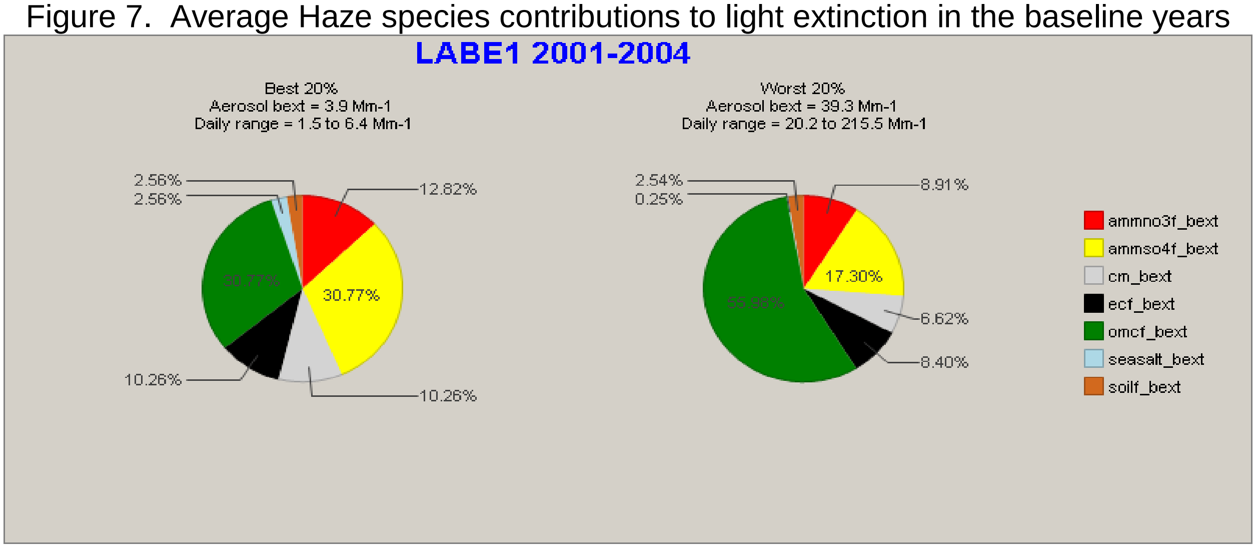
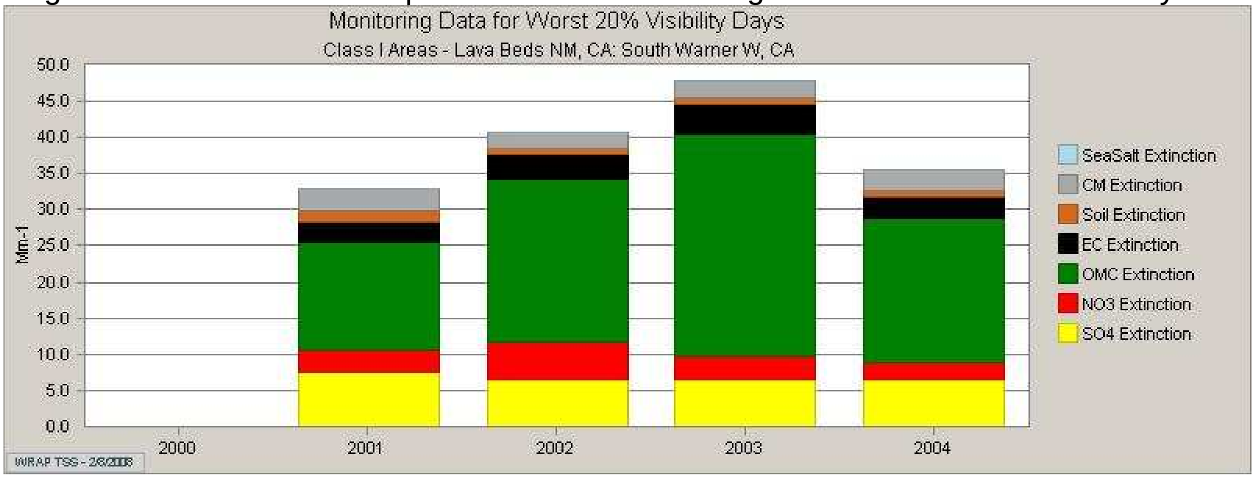


Figure 8. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 7 and 8, organic matter, sulfates, and nitrates have the strongest contributions to degrading visibility on worst days at the LABE1 monitor. The worst days are dominated by organic matter while the best days are dominated equally by sulfates and organic matter. Data points for 2000 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 9 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter while sulfates increase slightly in the spring. Organic matter remains high throughout the summer. Organic matter clearly dominates the other haze species on worst days, but nitrates, sulfates, coarse mass and elemental carbon also contribute to the worst days in the summer. Sea salt and soil are present at the LABE1 monitor but in very small amounts.

Figure 10 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 9 for organic matter, nitrates, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 9. Species contribution on the 20% worst days in 2002

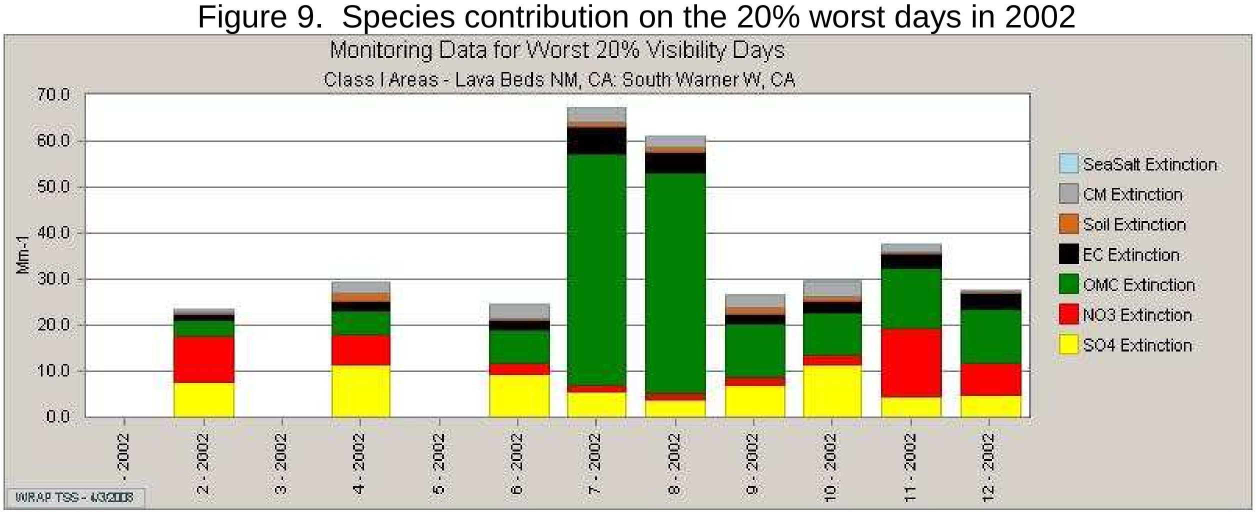
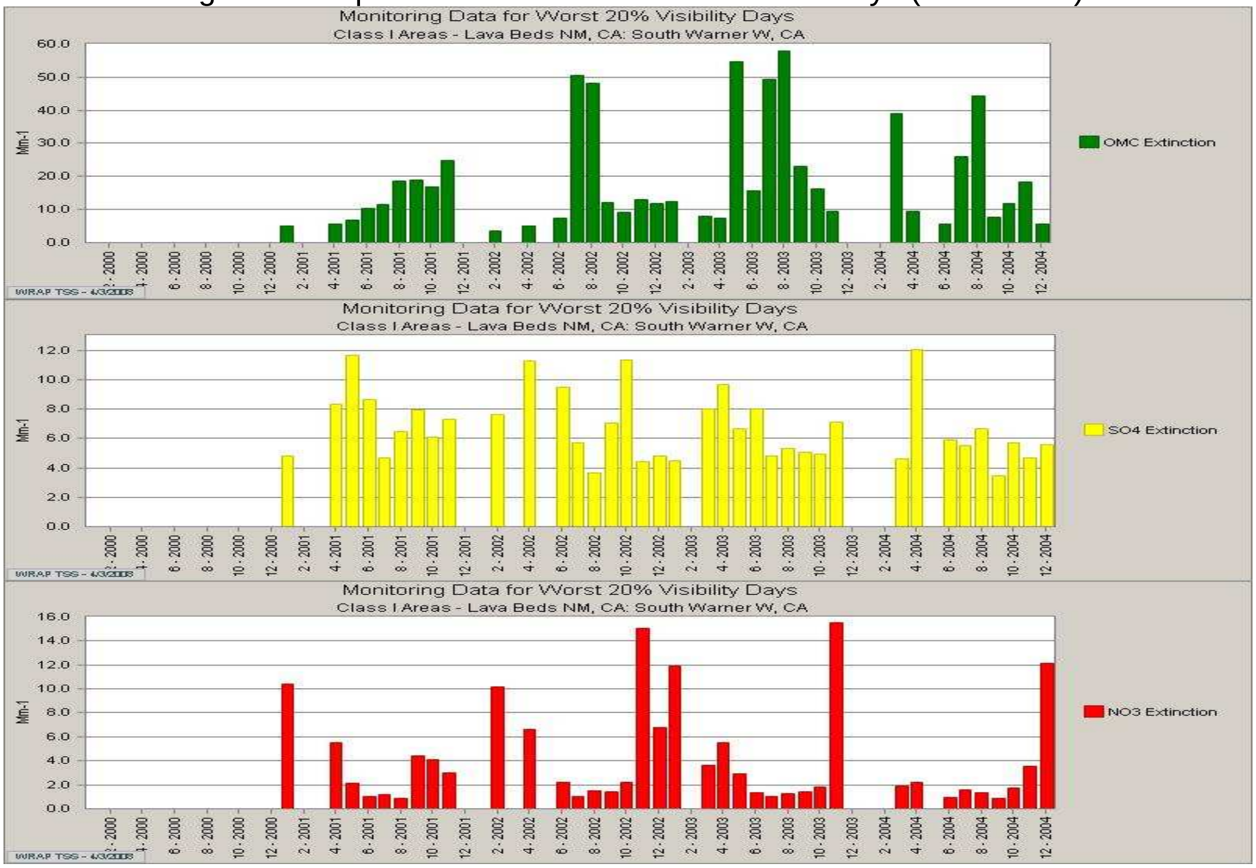


Figure 10. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at LABE1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 11 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the LABE1 monitor is from natural fire sources within Oregon. Oregon represents 67% of all natural fire source contributions.

Figure 12 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 76% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 22% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 13 and 14 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at LABE1. The Outside Domain region represents 53% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (31%) and the Pacific Offshore Region (11%). California contributes 13% of the total sulfate emissions seen at the LABE1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the LABE1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore Region.

Figures 15 and 16 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (74%), followed by the Outside Domain Region (21%) and emissions from Pacific Offshore (4%). Mobile sources within California contribute the most nitrate at the LABE1 monitor. In 2002, 51% of the nitrate at the LABE1 monitor can be attributed to California. California accounts for 69% of all mobile source nitrate emissions. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 11. Organic carbon source contribution from CA and outside regions

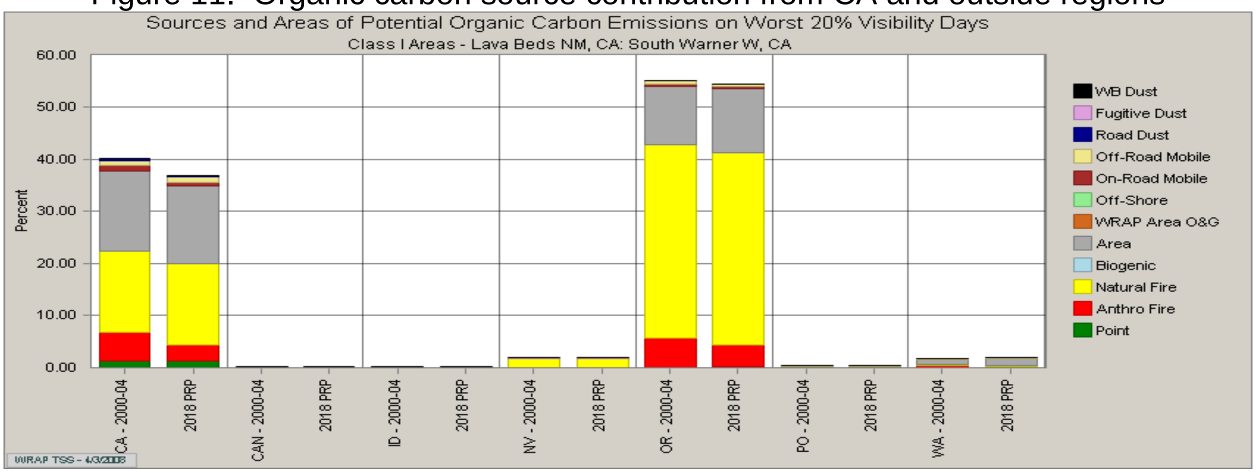


Figure 12. Organic carbon Anthropogenic and Biogenic Source Apportionment

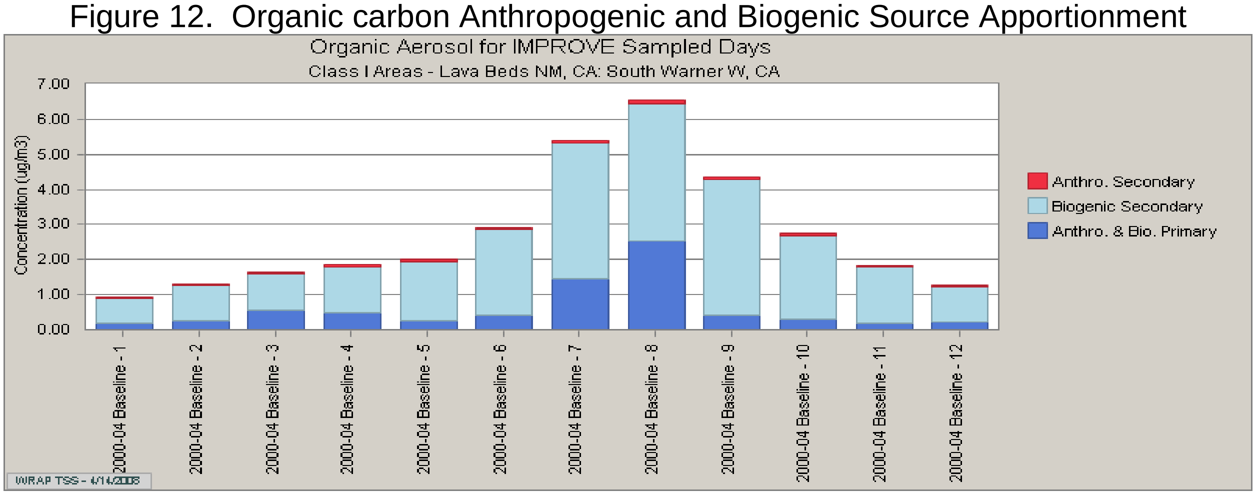


Figure 13. Regional Sulfate contribution to Haze in 2002 and 2018

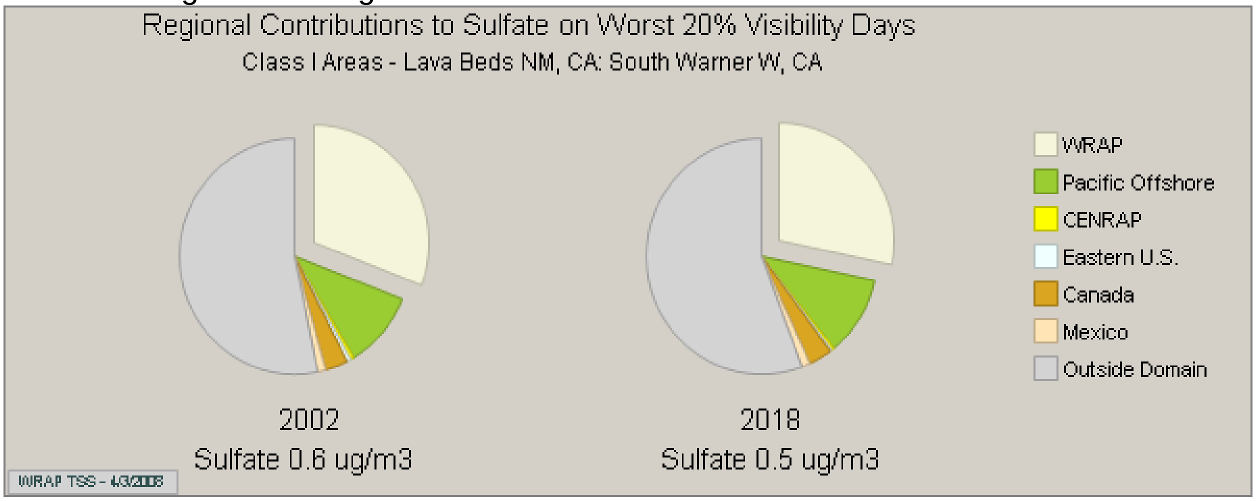


Figure 14. Sulfate source contribution from CA and outside regions

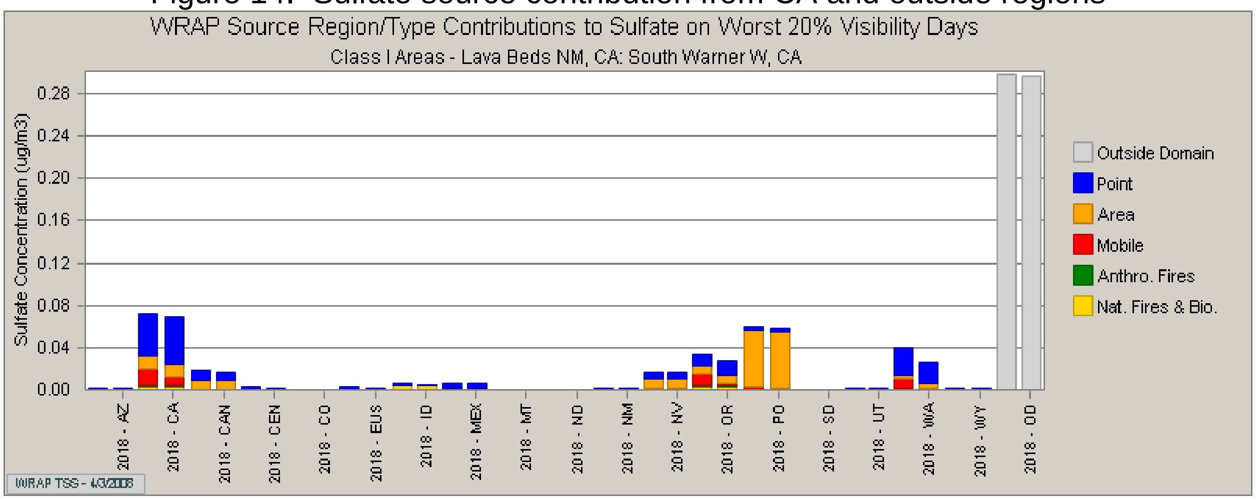


Figure 15. Regional Nitrate contribution to Haze in 2002 and 2018

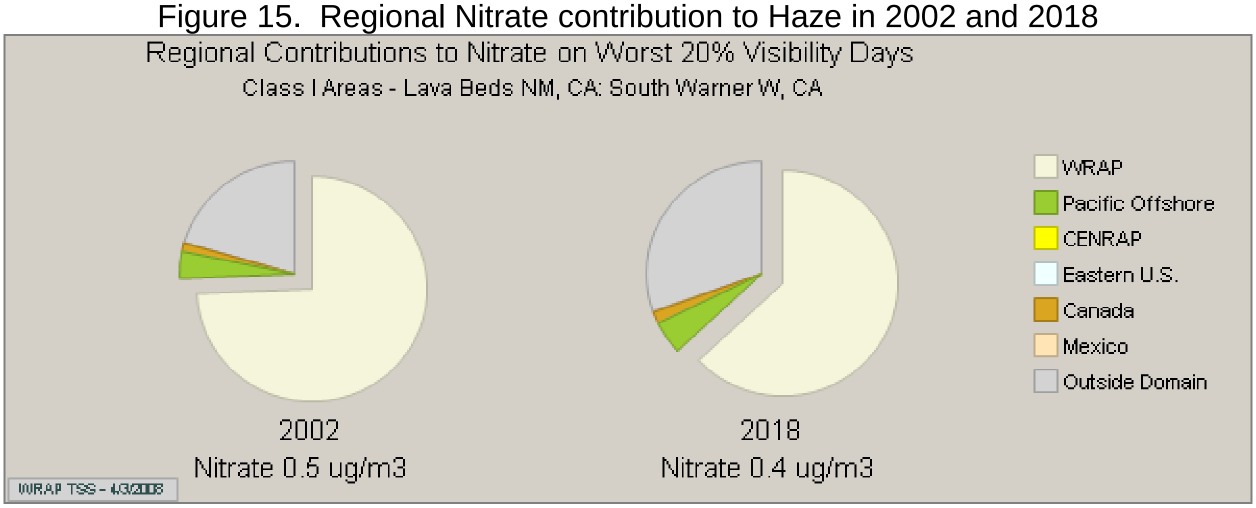
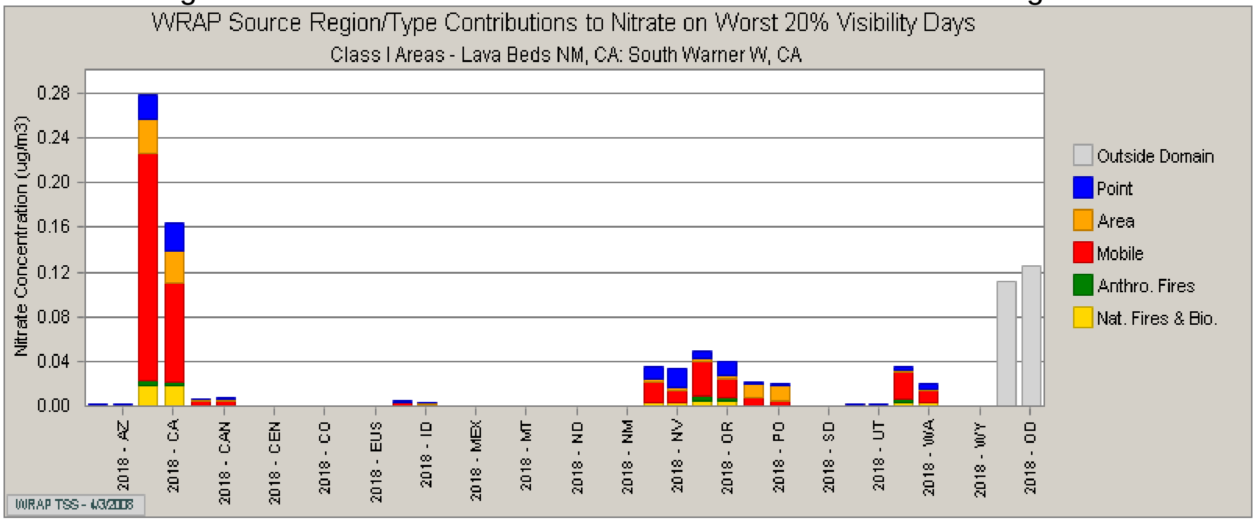


Figure 16. Nitrate source contribution from CA and outside regions



LAVO1 Monitor

The LAVO1 monitor location represents three wilderness areas located in Northern California near the Southern extreme of the Cascade Range. The wilderness areas associated with the LAVO1 monitor are Caribou Wilderness Area, Lava Beds Wilderness area and South Warner Wilderness area. The LAVO1 site has been operating since March 1988. This site has sufficient data for the entire baseline period.

Section I. LABE1 Wilderness Area Descriptions

I.a. Caribou Wilderness Area

The Caribou Wilderness Area (Caribou) consists of 20,500 acres in Northern California at the southern extreme of the Cascade Range and immediately adjacent to Lassen Volcanic National Park on its west side. Elevations range from nearly 1829 meters to the highest point, Red Cinder, at 2551 meters. The headwaters of the Susan River, which flows eastward towards Susanville and Honey Lake on the east slope of the Cascade Range, originate in Caribou Wilderness.

Figure 1. Caribou Wilderness Area

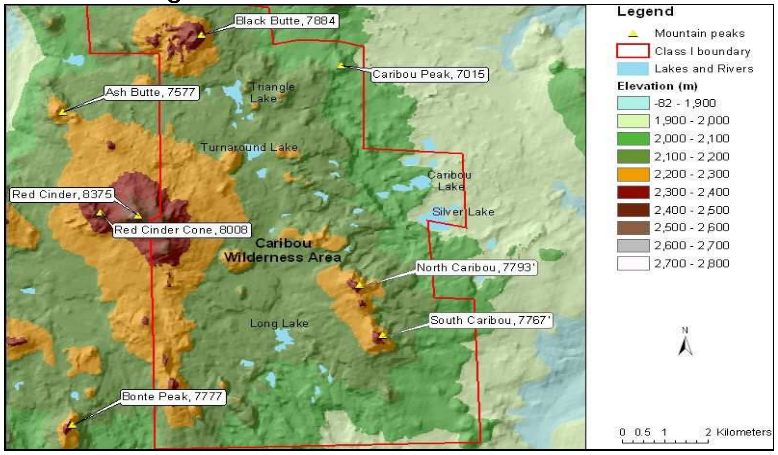


Figure 2. Image of Caribou Wilderness Area

I.b. Lassen Volcanic National Park

Lassen Volcanic National Park (Lassen) consists of 105,800 acres in northern California, at the southern extreme of the Cascade Range. Lassen consists of slopes and area surrounding Lassen Peak, elevation 3,187 meters. Lassen terrain consists of several volcanic cones in addition to Lassen Peak, and surrounding and intervening terrain. Lowest elevations are near 1,707 meters at points where streams exit the park. The entire Lassen park area is generally in terrain to the east of the north end of the Sacramento Valley, and is thus subject to upwind flow from the south and west, the directions to northern Sacramento Valley communities of Redding, Red Bluff, and Chico roughly 50 miles to the west, west-southwest, and south-southwest respectively. Typical northern Sacramento Valley elevations are 152 to 183 meters, or about 1,524 meters lower than the lowest Lassen elevations.

Figure 3. LAVO1 Monitor location

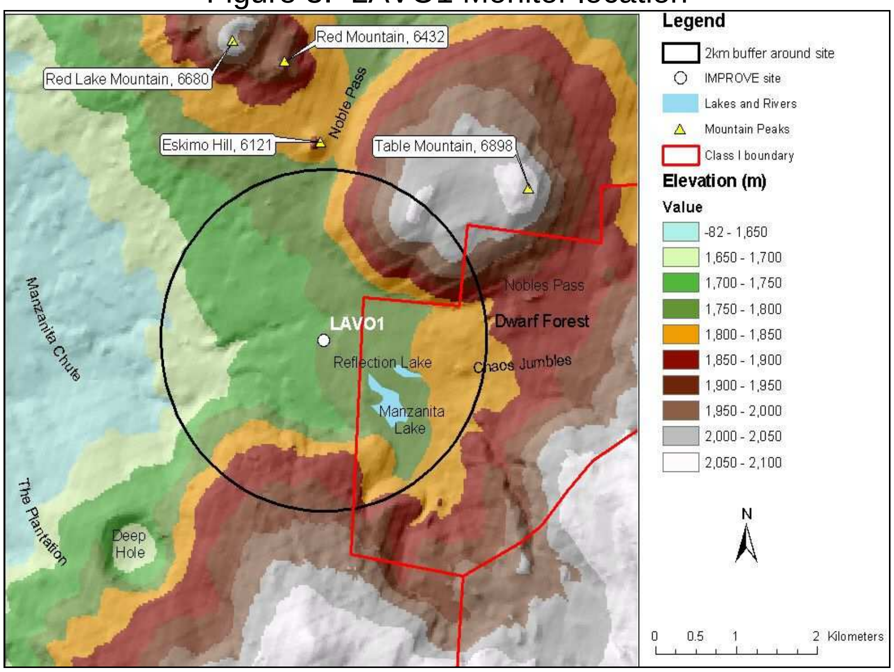


Figure 4. Image of Lassen Volcanic National Park

I.c. Thousand Lakes Wilderness Area

The Thousand Lakes Wilderness Area (Thousand Lakes) consists of 16,335 acres, 10 miles northwest of Thousand Lakes Wilderness Area near the southern extreme of the Cascade Range. It consists mainly of slopes extending downward from Crater Peak, elevation 2,645 meters. The lowest Wilderness elevation is 1,690 meters at the base of Crater Peak. The Thousand Lakes Wilderness Area, Thousand Lakes Wilderness Area and the Caribou Wilderness are in the same general area and all share the same general topographic features.

Figure 5. WINHAZE image of Thousand Lakes Wilderness Area (2.7 vs. 14.1 dv)

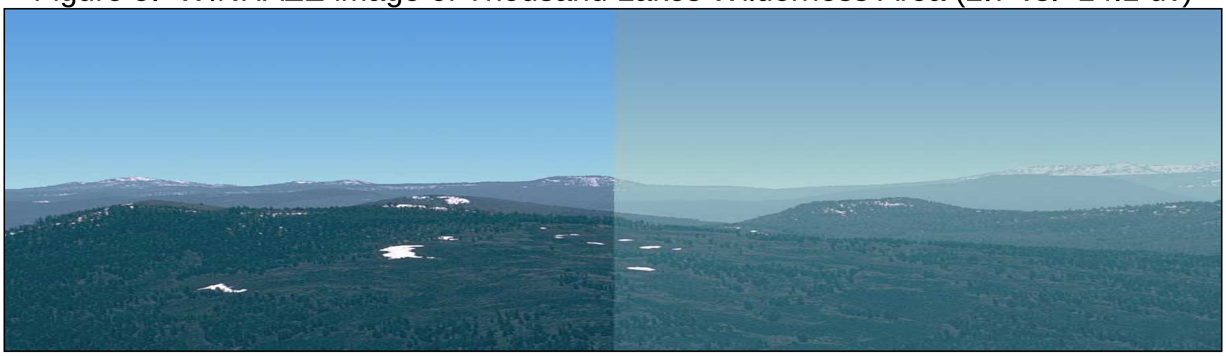


Figure 6. LAVO1 Monitor location in California

Section II. Visibility Conditions:

II.a. Caribou Wilderness Area

Visibility conditions for Caribou are currently monitored by the LAVO1 IMPROVE monitor located in Lassen Volcanic National Park, near the northwest entrance Ranger station. The monitor is located at 40.54 north latitude, 121.57 west longitude, 25 yards southeast of the Fire Station, at an elevation of 1733 meters. The site may be influenced by channeled flow in the Manzanita Creek drainage which flows west from the National Park and ultimately to the northern Sacramento Valley.

The Caribou Wilderness Area, Lassen Volcanic National Park, and Thousand Lakes Wilderness Area are in the same general area and share the same general topographic features. The Caribou Wilderness has a somewhat more direct link to the eastern slopes of the Cascades via the Susan River that flows into Honey Lake in northeastern California, approximately 50 miles east of the Wilderness. Caribou Wilderness may see somewhat more influence by sources on the western slope of the Cascade Range during infrequent east-west transport conditions that may not be represented by data from LAVO1. Potential haze sources on the eastern slopes of the Cascade Range include dry and intermittent lakes, sources of alkali dust, and windblown desert dust that could impact the Wilderness during extreme dust storms with an easterly direction component.

The LAVOI location is adequate for assessing the 2018 reasonable progress goals for the Caribou Wilderness Class 1 area.

II.b. Lassen Volcanic National Park

Visibility conditions for Lassen are currently monitored by the LAVO1 IMPROVE monitor. The monitor is located at 40.5398 north latitude and 121.5768 west longitude, near the northwest park entrance Ranger station, 25 yards southeast of the Fire Station, at an elevation of 1,733 meters. The site may be influenced be channeled flow in the Manzanita Creek drainage that flows west from the Park and ultimately to the northern Sacramento Valley.

The monitoring location is near the low end of the range of Lassen elevations. It should be representative of park locations in general. During surface inversion conditions, it should still be representative of lower elevations, and hence of worst (highest aerosol concentrations) conditions. It is located within or near the Manzanita Creek drainage that is a channel for nighttime drainage flow. The closest source region with emissions that may contribute to aerosol and haze in Lassen is the northern Sacramento Valley. Lassen may also be linked to emissions form the Sacramento area 120 to 150 miles south and from the San Francisco Bay area, during low level southerly flow through the central valleys.

The LAVOI location is adequate for assessing the 2018 reasonable progress goals for the Lassen Volcanic National Park Class 1 area.

II.c. Thousand Lakes Wilderness Area

Visibility conditions for Thousand Lakes are currently monitored by the LAVO1 IMPROVE monitor located near the entrance to Thousand Lakes Wilderness Area. The monitor is located at 40.5398 north latitude and 121.5768 west longitude, near the northwest park entrance Ranger station, 25 yards southeast of the Fire Station, at an elevation of 1,733 meters. The site may be influenced be channeled flow in the Manzanita Creek drainage that flows west from the Park and ultimately to the northern Sacramento Valley.

The monitoring location should be representative of park locations in general. During surface inversion conditions, it should still be representative of lower elevations, and hence of worst (highest aerosol concentrations) conditions. It is located within or near the Manzanita Creek drainage which is a channel for nighttime drainage flow. The closest source region with emissions that may contribute to aerosol and haze in Thousand Lakes Wilderness is the northern Sacramento Valley. Thousand Lakes may also be linked to emissions form the Sacramento area 120 to 150 miles south and from the San Francisco Bay area, during low level southerly flow through the central valleys.

The LAVO1 location is adequate for assessing the 2018 reasonable progress goals for the Thousand Lakes Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from LAVO1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the LAVO1 monitor is calculated at 2.7 deciviews for the 20% best days and 14.1 deciviews for the 20% worst days. Figure 7 represents the worst baseline visibility conditions.

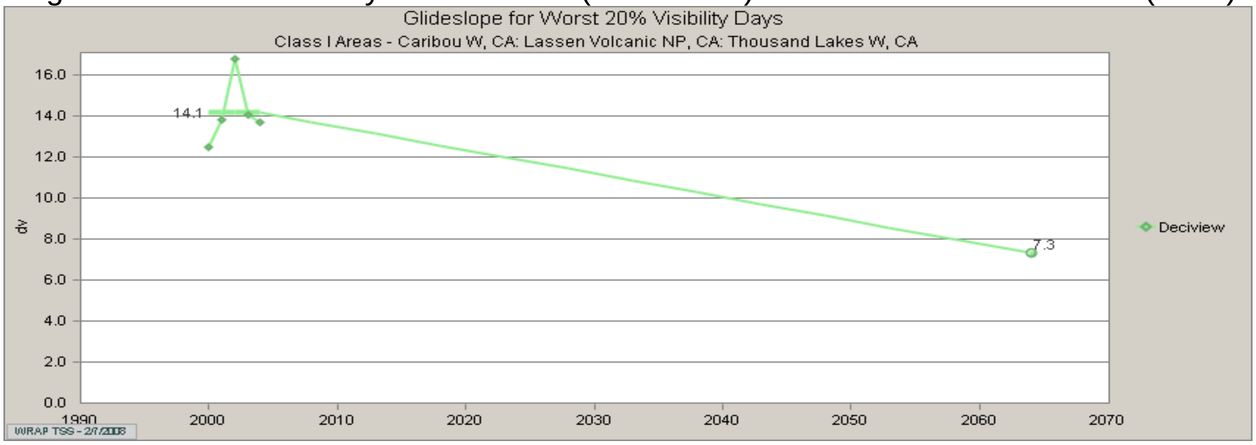
II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the LAVO1 monitor is 1.0 deciviews for the 20% best days and 7.3 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 7 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 12.55 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 2.7 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 7. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 8 shows the contribution of each species to the 20% best and worst days in the baseline years at LAVO1.

Figure 8. Average Haze species contributions to light extinction in the baseline years

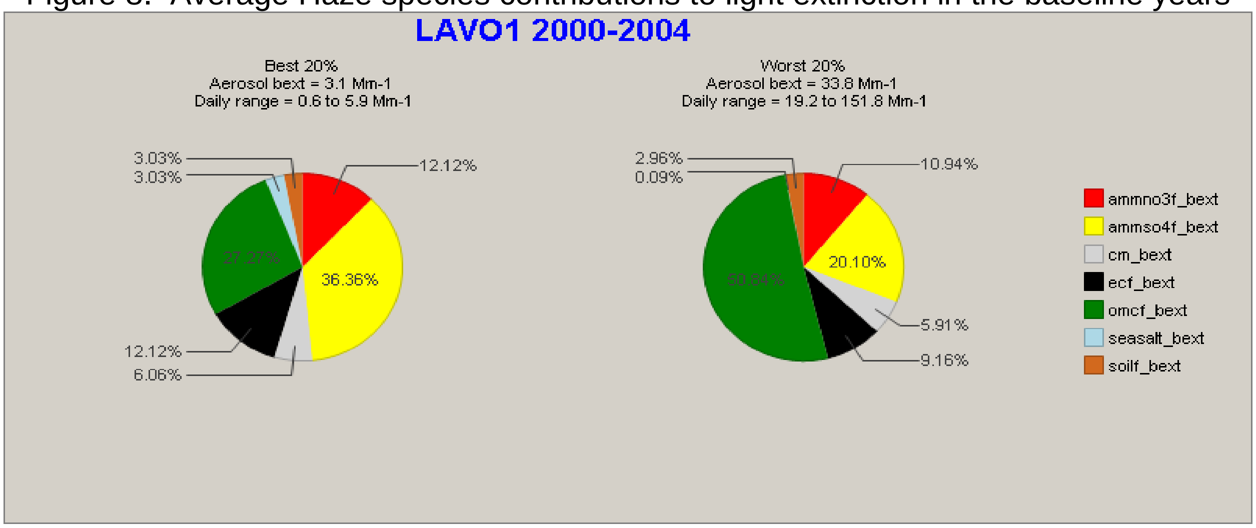
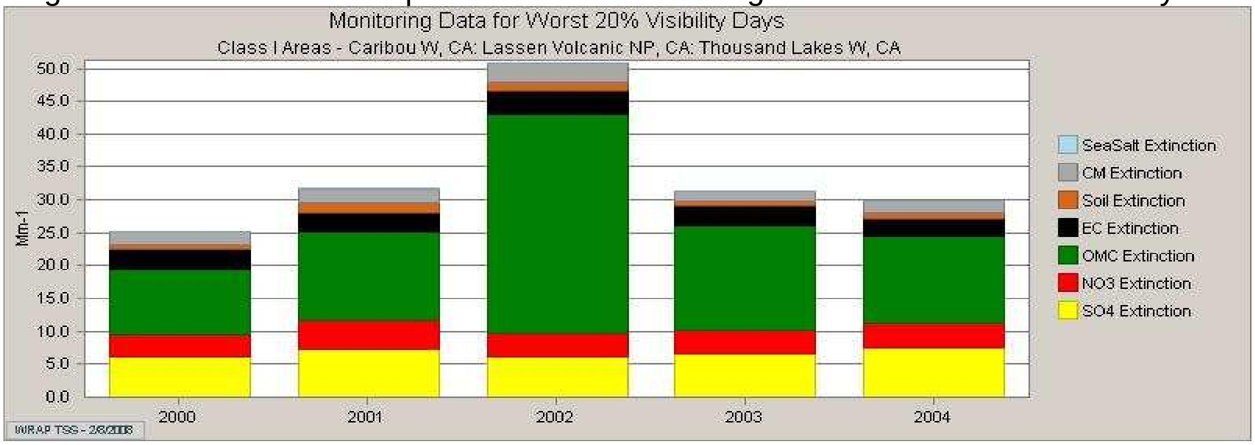


Figure 9. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 8 and 9, organic matter, sulfates, and nitrates have the strongest contributions to light extinction which degrades visibility on worst days at the LAVO1 monitor. The worst days are dominated by organic matter, while the best days are dominated by sulfate.

Figure 10 depicts the individual species contribution to worst days in 2003. Nitrates increase in the winter while sulfates increase slightly in the spring. Organic matter remains high throughout the summer. Organic matter clearly dominates the other haze species on worst days, but nitrates, sulfates, coarse mass and elemental carbon also contribute to the worst days in the summer. Sea salt is not present at the LAVO1 monitor.

Figure 11 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 10 for organic matter, nitrates, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 10. Species contribution on the 20% worst days in 2003

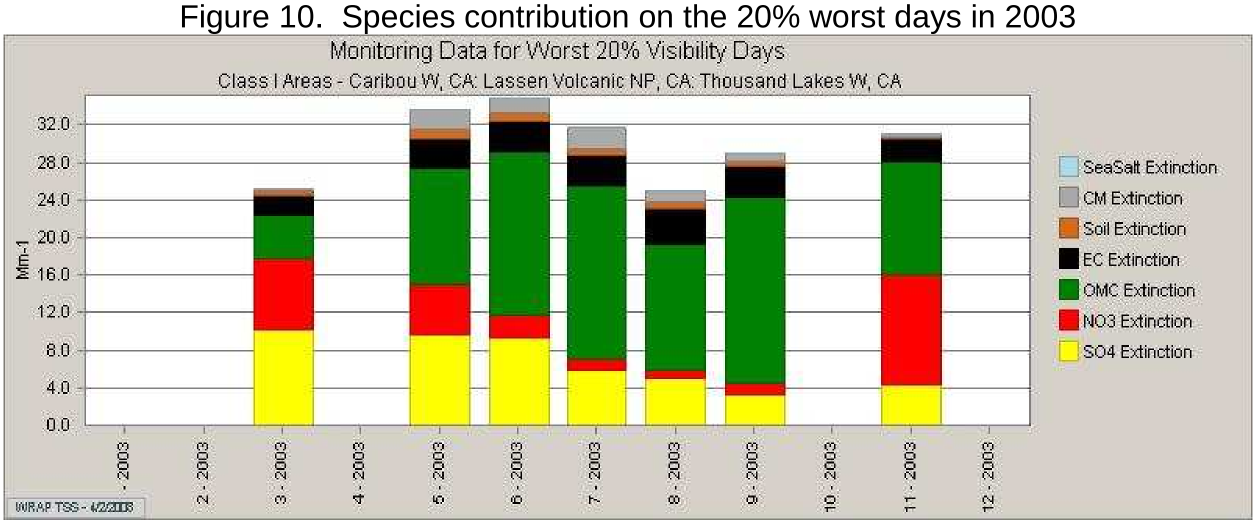
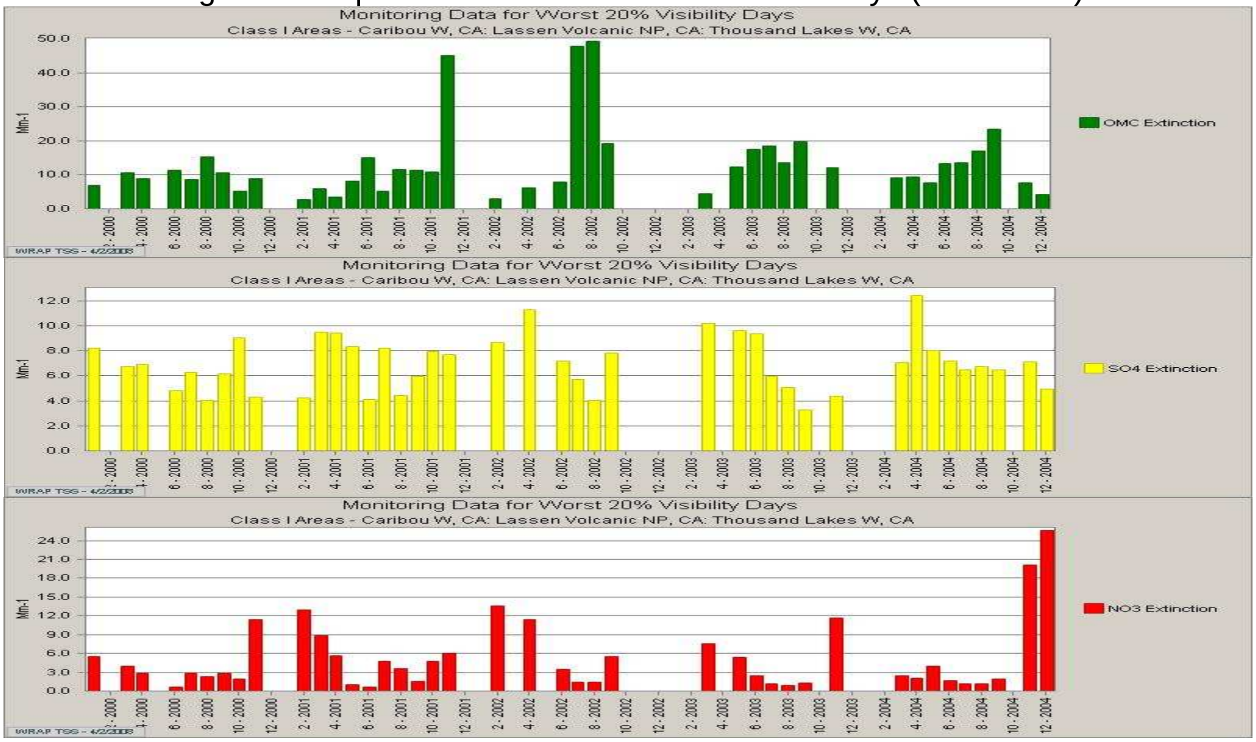


Figure 11. Species contribution on 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at LAVO1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 12 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the LAVO1 monitor is from area sources within California. California represents 90% of all area source contributions.

Figure 13 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 70% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 27% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 14 and 15 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at LAVO1. The WRAP region represents 41% of the sulfate contributions in 2002 and 2018, followed by the emissions from the Outside Domain

Region (37%) and the Pacific Offshore Region (17%). California contributes 20% of the total sulfate emissions seen at the LAVO1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the LAVO1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore.

Figures 16 and 17 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (82%), followed by the Outside Domain Region (12%) and emissions from Pacific Offshore (6%). Mobile sources within California contribute the most nitrates at the LAVO1 monitor. In 2002, 72% of the nitrate at the LAVO1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most to nitrate concentrations at the LAVO1 monitor in 2002 and 2018. Currently, California mobile sources are 74% of California contributions to nitrate at the LAVO1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 12. Organic carbon source contribution from CA and outside regions

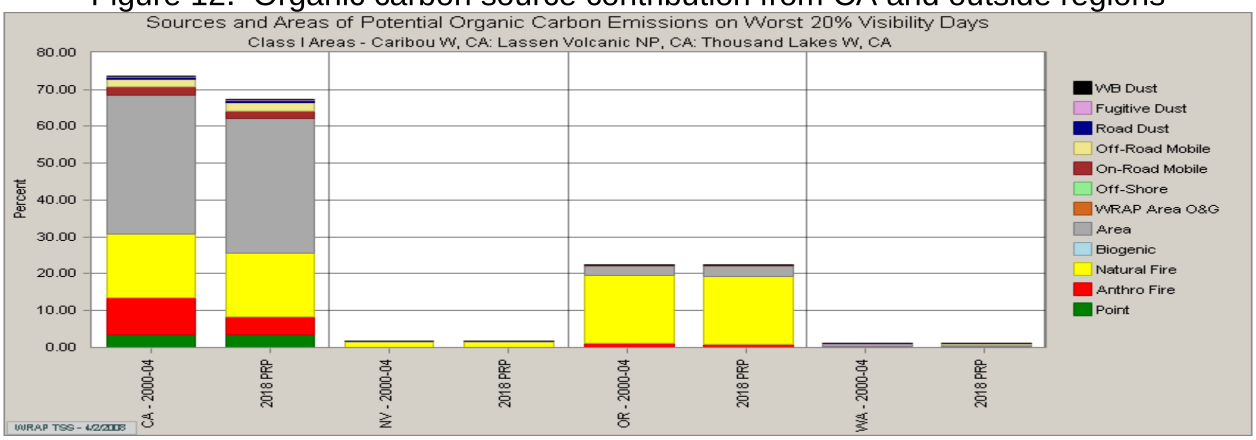


Figure 13. Organic carbon Anthropogenic and Biogenic Source Apportionment

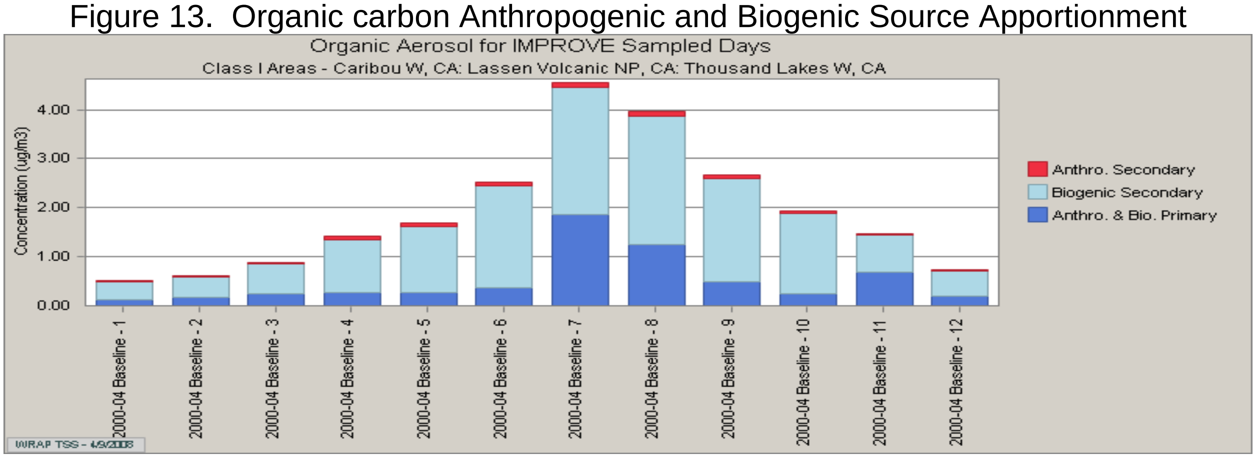


Figure 14. Regional Sulfate Contribution to Haze in 2002 and 2018

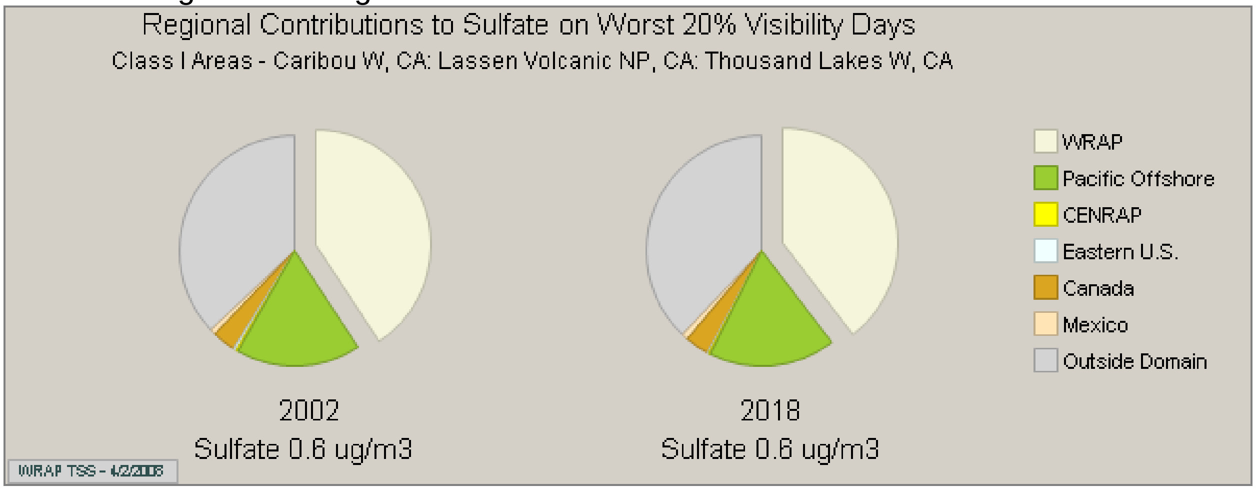


Figure 15. Sulfate source contribution from CA and outside regions

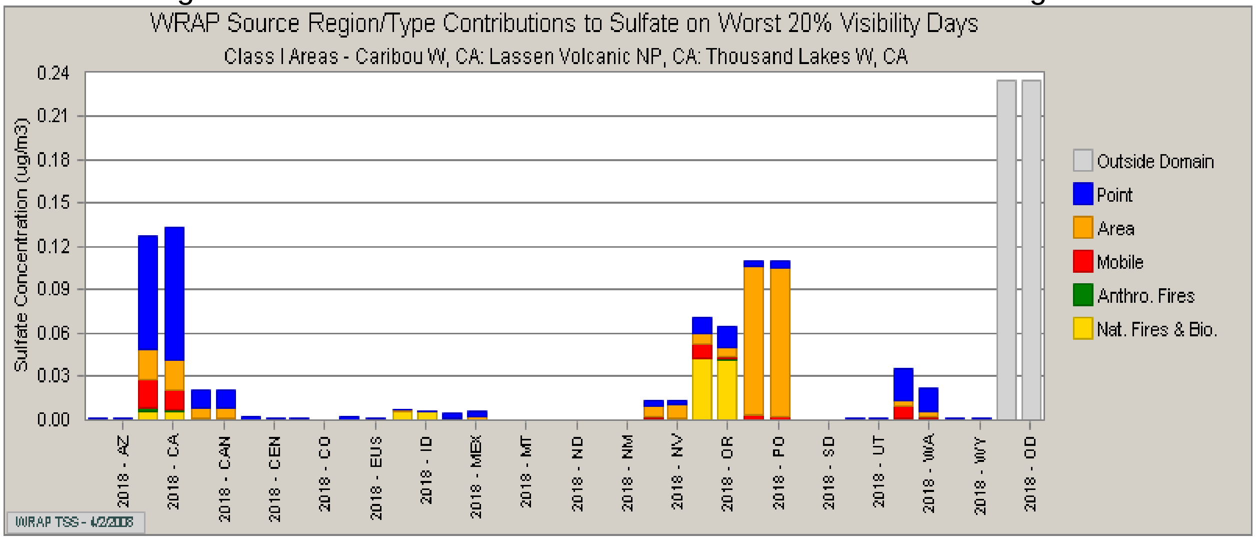


Figure 16. Regional Nitrate Contribution to Haze in 2002 and 2018

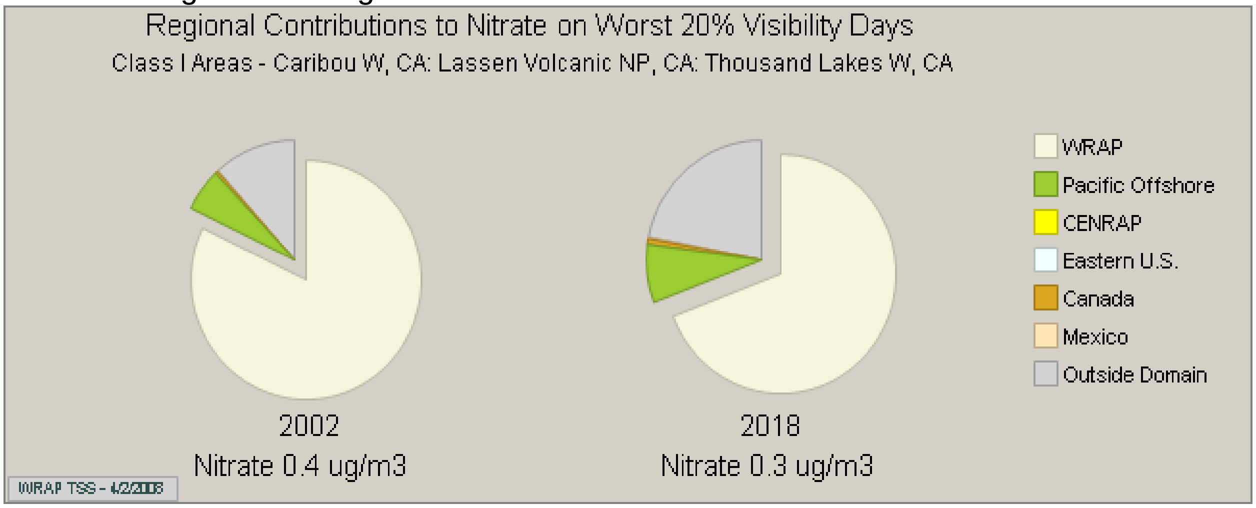
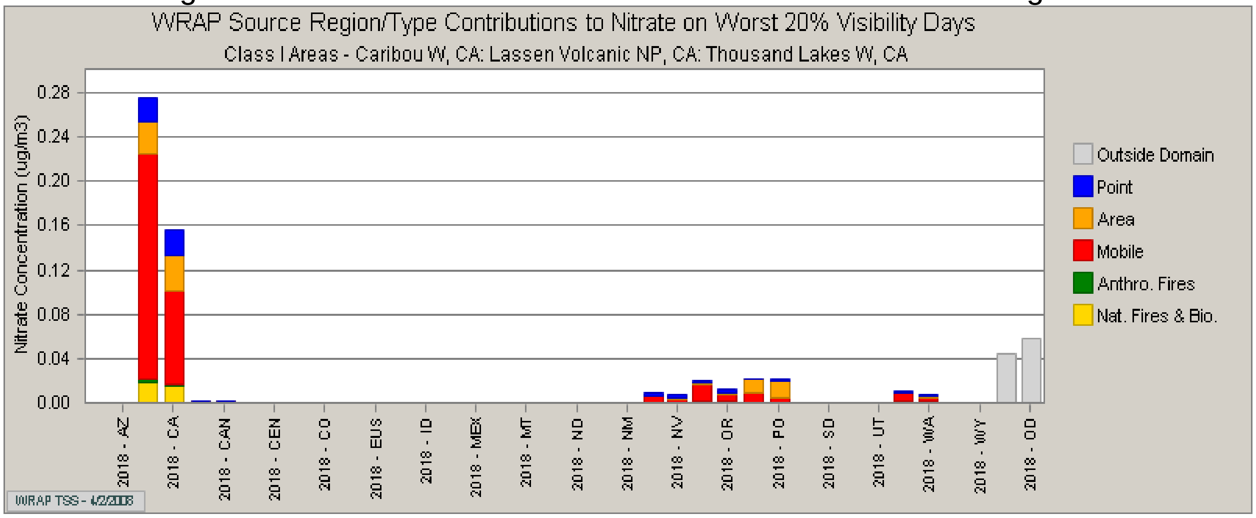


Figure 17. Nitrate source contribution from CA and outside regions



BLIS1 Monitor

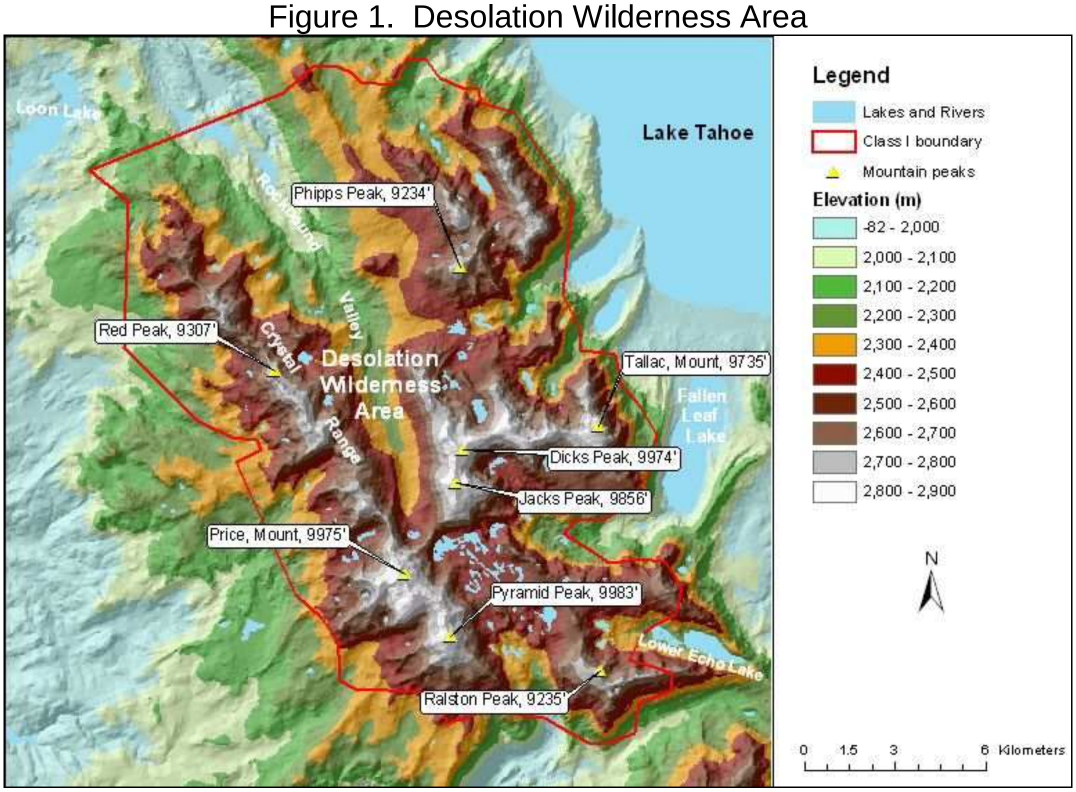
The BLIS1 monitor location represents two wilderness areas located along the crest of the Sierra Nevada mountain range, just west of Lake Tahoe. The wilderness areas associated with the BLIS1 monitor are Desolation Wilderness area and Mokelumne Wilderness area. The BLIS1 site has been operating since November 1990. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2004.

<u>Section I. BLIS1 Wilderness Area Descriptions</u>

I.a. Desolation Wilderness Area

The Desolation Wilderness Area (Desolation Wilderness) consists of 63,500 acres directly to the west of Lake Tahoe. It is bisected by the Rubicon River that flows northward from its source in the southern Wilderness to eventually flow into the headwaters of the American River and towards the San Joaquin Valley of central California. Wilderness elevations range from around 1,981 meters to 3,048 meters at the highest peaks. Lowest elevations are thus near Lake Tahoe's elevation of 1,897 meters. The nearest source of local emissions is probably the Lake Tahoe basin, immediately east of the Desolation Wilderness. However, most of the Wilderness is not part of the nearby Lake Tahoe air shed, although easternmost east facing slopes are.

Figure 1. Desolation Wilderness Area



I.b. Mokelumne Wilderness Area

The Mokelumne Wilderness Area (Mokelumne) consists of 105,165 acres and straddles the crest of the central Sierra Nevada range 15 to 20 miles south of Lake Tahoe. Watersheds drain to the Mokelumne River on the west slope and the Carson River on the east slope. The Mokelumne River opens up into the central San Joaquin Valley about 50 miles to the west. The prominent Wilderness topographic feature is the Mokelumne River Canyon. Elevations range from about 1,189 meters near Salt Springs Reservoir where the Mokelumne River exits the Wilderness on the south side to 3,164 meters at Round Top on the north side. Precipitation averages 50 inches annually on the west slope and as little as 15 inches on the east slope, 80 percent of it in the form of snow.

Figure 2. Mokelumne Wilderness Area

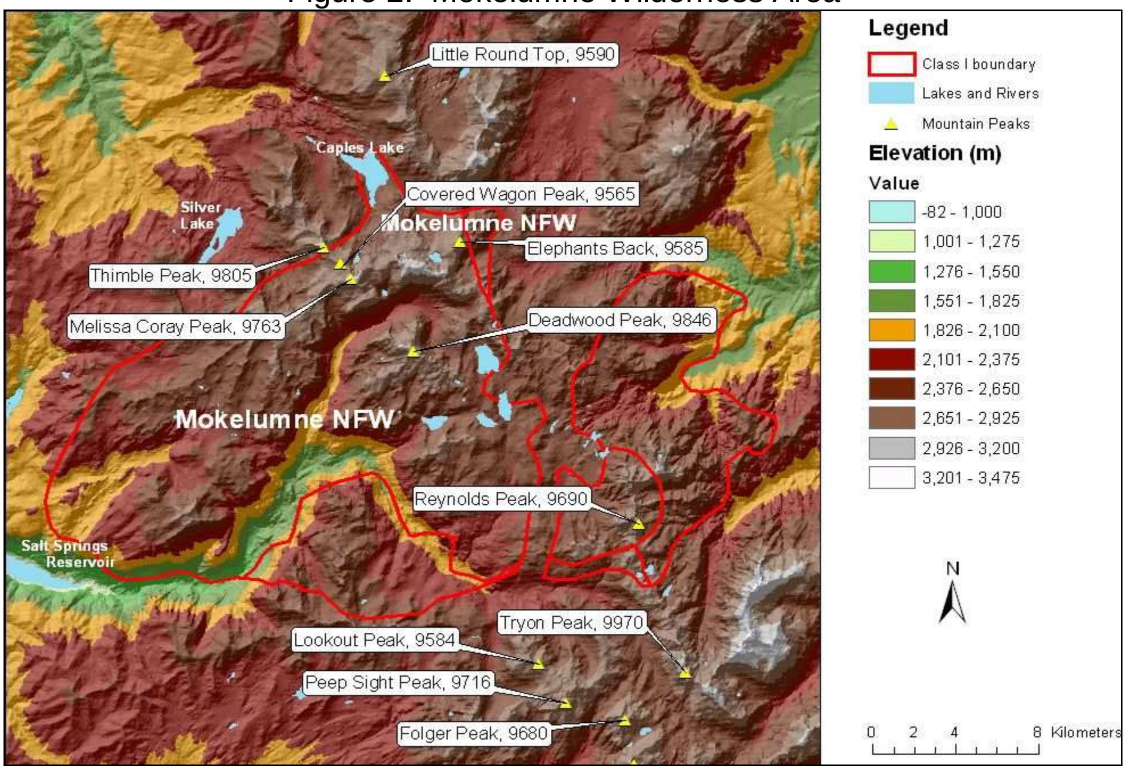
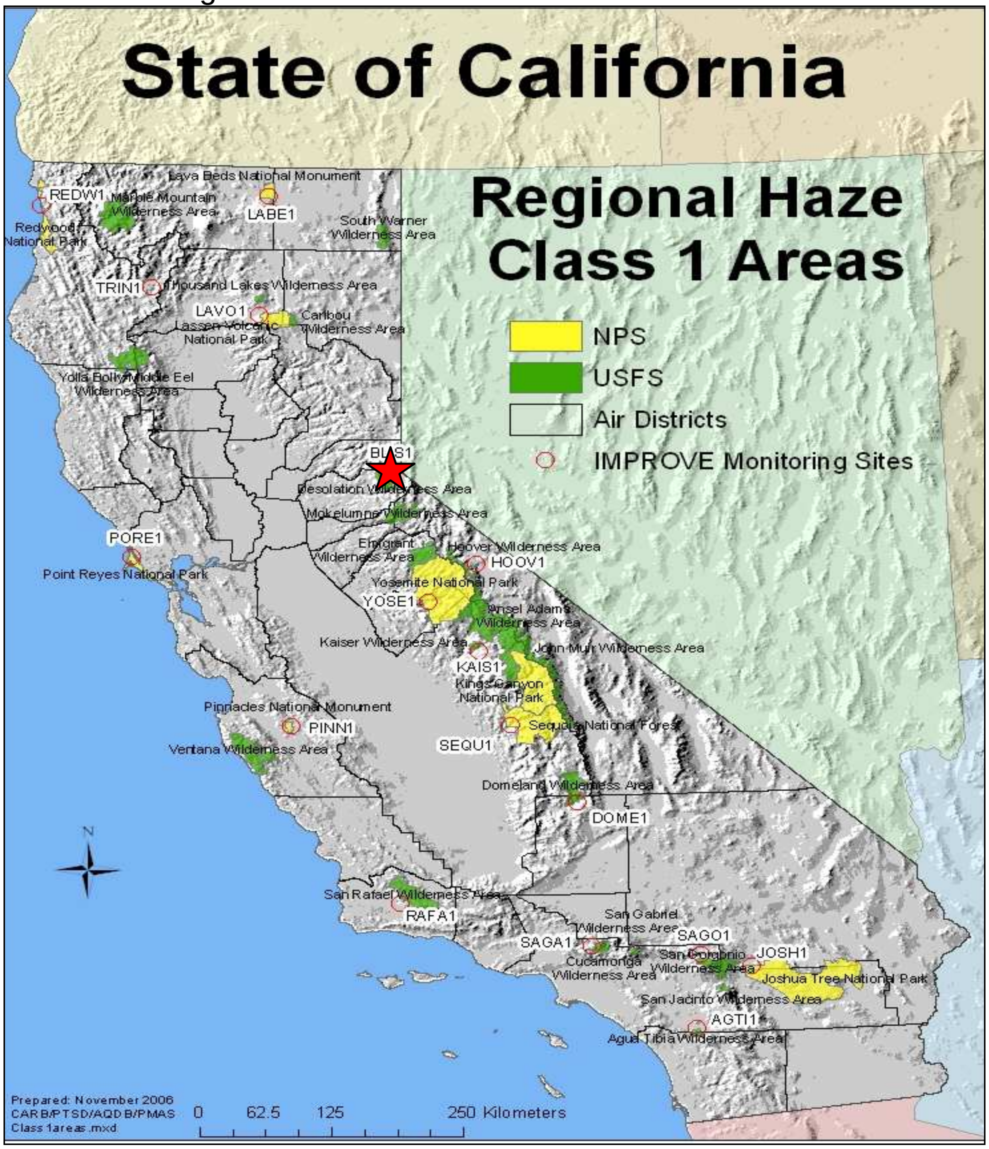


Figure 3. BLIS1 Monitor location in California



Section II. Visibility Conditions:

II.a. Desolation Wilderness Area

Visibility conditions for Desolation Wilderness are currently monitored by the BLIS1 IMPROVE monitor located at Bliss State Park. The monitor is located at 38.9761 north latitude, 120.1035 west longitude, near the western shore of Lake Tahoe at an elevation of 2,131 meters, about 219 meters above the shore of Lake Tahoe and near lowest elevations on the eastern slopes of Desolation Wilderness.

The BLIS1 monitoring site is about 219 meters above the shore of Lake Tahoe, and near the lowest Wilderness locations on slopes facing Tahoe Basin. It is likely more susceptible to local and trapped emissions in the Tahoe Basin that do not extend to higher Desolation Wilderness elevations. It is probably representative of Desolation

Wilderness locations on lower eastern slopes facing Lake Tahoe that may be worst case conditions overall, and during conditions of uniform regional haze. The closest source region with emissions that could contribute to haze in the Desolation Wilderness is the Lake Tahoe Basin. The more distant central Valley of California near Sacramento, from which emissions could be transported to Desolation Wilderness, is about 50 miles southwest, linked to Desolation Wilderness by the American River and Rubicon River. The Reno, Nevada area is about the same distance to the northeast but is generally downwind for prevailing wild directions and in a distant air shed.

Potential emission transport from source regions to the west in the California Central Valley occurs mainly in the summer. Locally, eastern Wilderness locations may be predominantly influenced by emissions within the Tahoe Basin. Highest summertime measured concentrations at BLIS1 are associated with regional forest fire events. In the absence of such regional events there is likely to be a significant contribution from vehicle traffic in the Tahoe Basin to aerosol measures at BLIS1. In the fall and winter there may be wood smoke impacts associated with prescribed burns and residential burning in the Tahoe Basin.

The BLISI location is adequate for assessing the 2018 reasonable progress goals for the Desolation Wilderness Class 1 area.

II.b. Mokelumne Wilderness Area

Visibility conditions for Mokelumne are currently monitored by the BLIS1 IMPROVE monitor located at Bliss State Park. The monitor is located at 38.9761 north latitude and 120.1035 west longitude near the western shore of Lake Tahoe at an elevation of 2,131 meters, about 219 meters above the shore of Lake Tahoe.

The BLIS1 IMPROVE site is close to and about 219 meters above the shore of Lake Tahoe, within the Tahoe Basin. There is no direct link to Mokelumne Wilderness, which is generally outside of the Tahoe Basin, except via the headwaters of the Upper Truckee River, separated from the Wilderness by higher terrain. BLIS1 is likely more susceptible to local and trapped emissions in the Tahoe basin that do not extend to Mokelumne Wilderness locations. It may be more representative of Mokelumne Wilderness locations during conditions of uniform regional haze. Emissions from Sacramento and Stockton, about 50 miles southwest, could be transported to the Mokelumne Wilderness, via the Mokelumne River. The Reno Nevada area is about the same distance to the northeast but is generally downwind for prevailing wind directions and in a distant air shed.

The BLIS1 location is adequate for assessing the 2018 reasonable progress goals for the Mokelumne Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from BLIS1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the BLIS1 monitor is calculated at 2.5 deciviews for the 20% best days and 12.6 deciviews for the 20% worst days. Figure 4 represents the worst baseline visibility conditions.

II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the BLIS1 monitor is 0.4 deciviews for the 20% best days and 6.1 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 4 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 11.10 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 2.5 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)

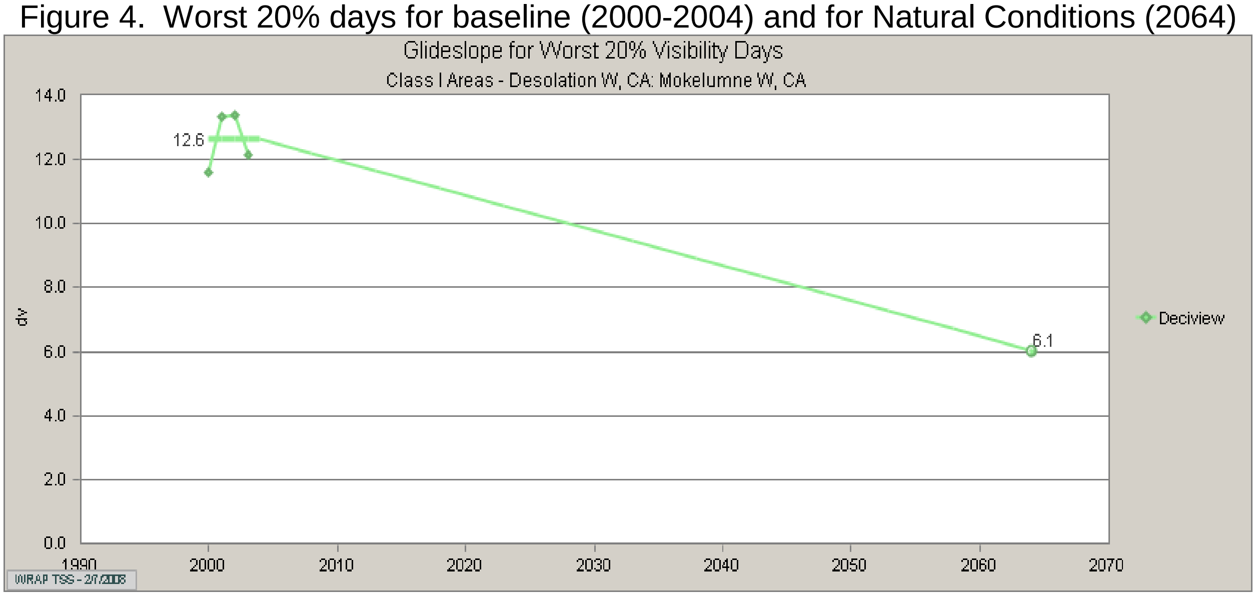
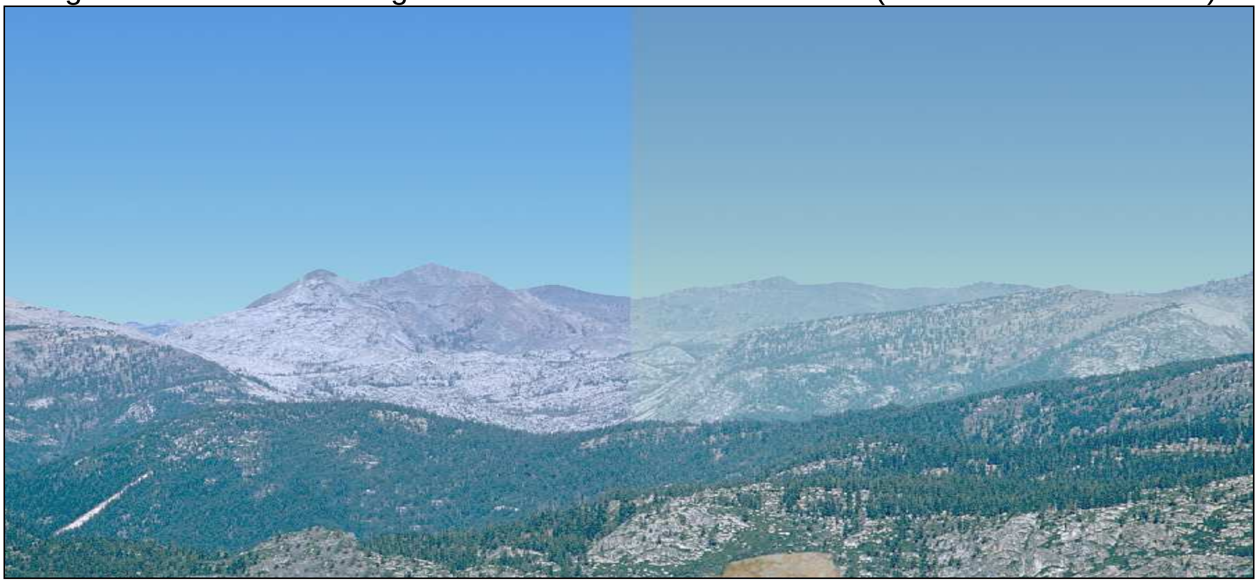


Figure 5. WINHAZE image of Desolation Wilderness Area (2.5 vs. 12.6 deciviews)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 6 shows the contribution of each species to the 20% best and worst days in the baseline years at BLIS1.

Figure 6. Average Haze species contributions to light extinction in the baseline years

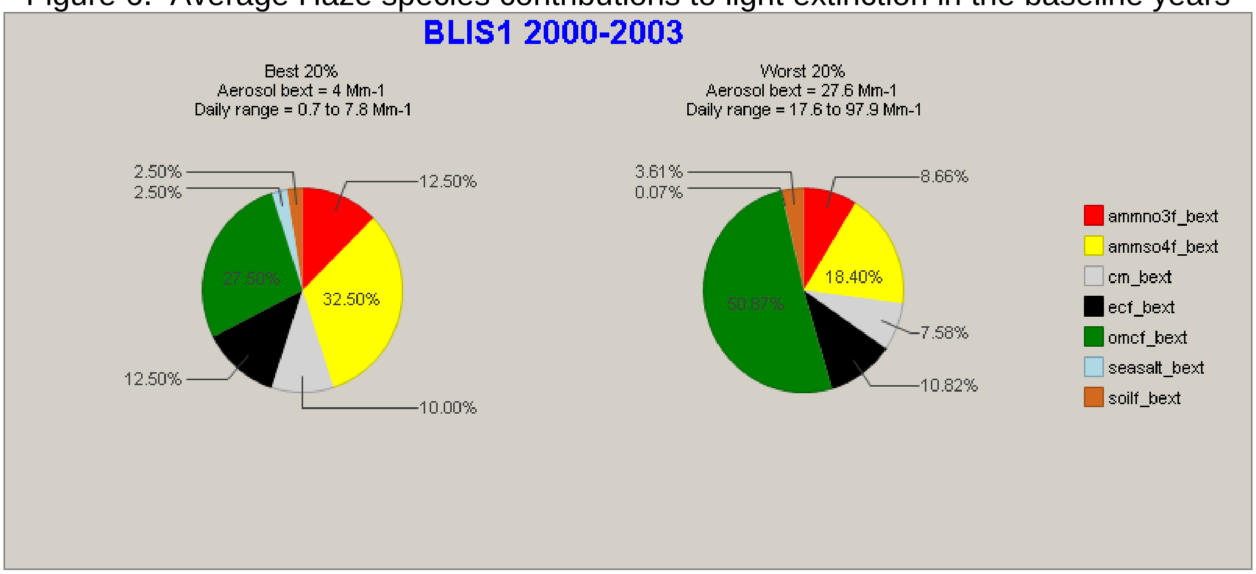
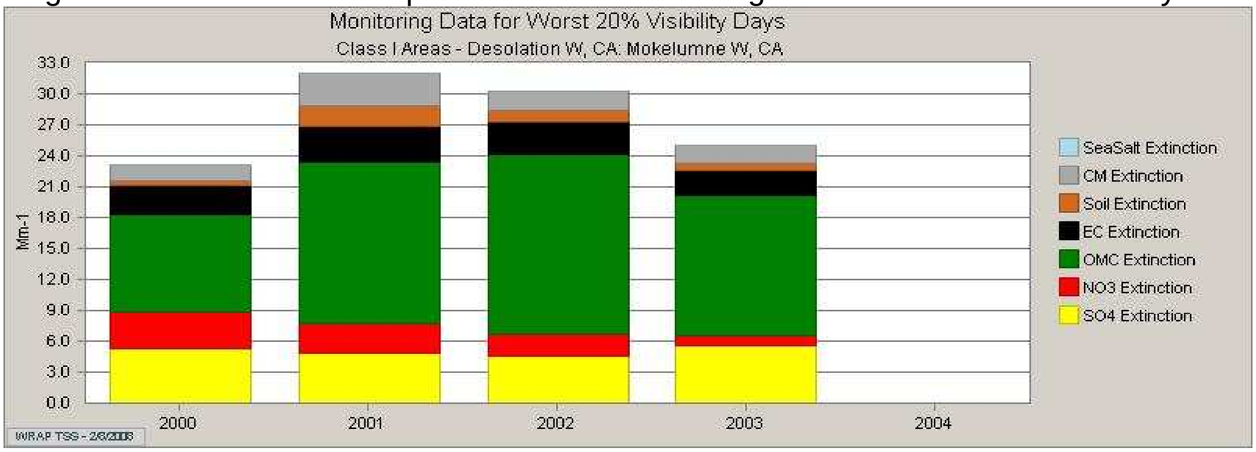


Figure 7. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 6 and 7, organic matter, sulfates, and elemental carbon have the strongest contributions to degrading visibility on worst days at the BLIS1 monitor. The worst days are dominated by organic matter, while the best days are dominated by sulfate. Data points for 2004 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 8 depicts the individual species contribution to worst days in 2002. Organic matter increases in the summer while sulfates increase slightly in the spring. The occurrence of elevated elemental carbon concentrations is sporadic throughout the year. Organic matter clearly dominates the other haze species on worst days, but sulfates, nitrates, elemental carbon, and coarse mass also contribute to the worst days. Sea salt has a very small contribution to haze at the BLIS1 monitor.

Figure 9 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 8 for organic matter, sulfates, elemental carbon, and nitrates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 8. Species contribution on the 20% worst days in 2002

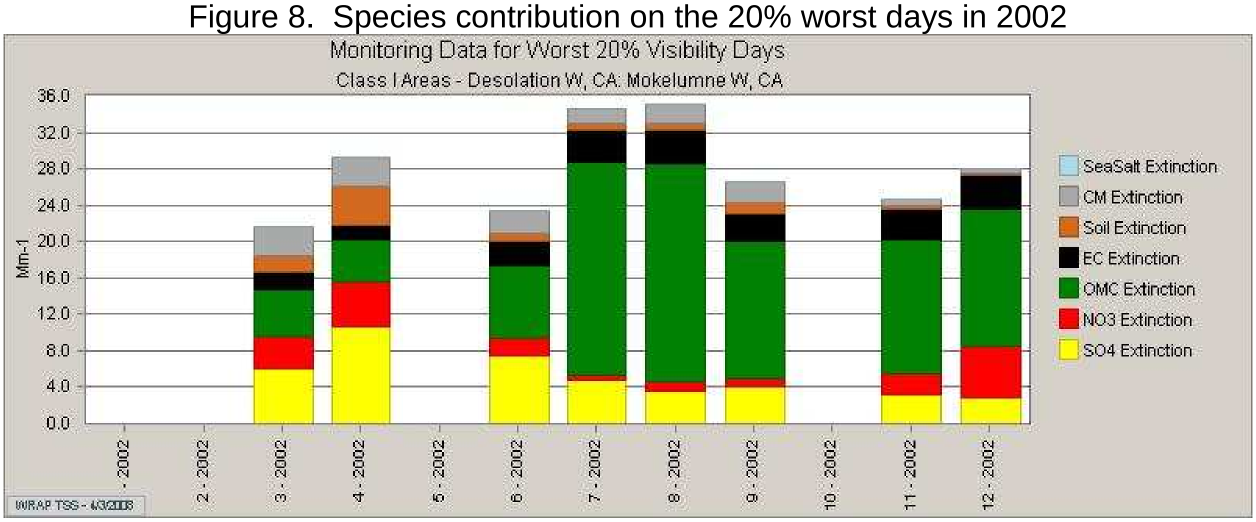
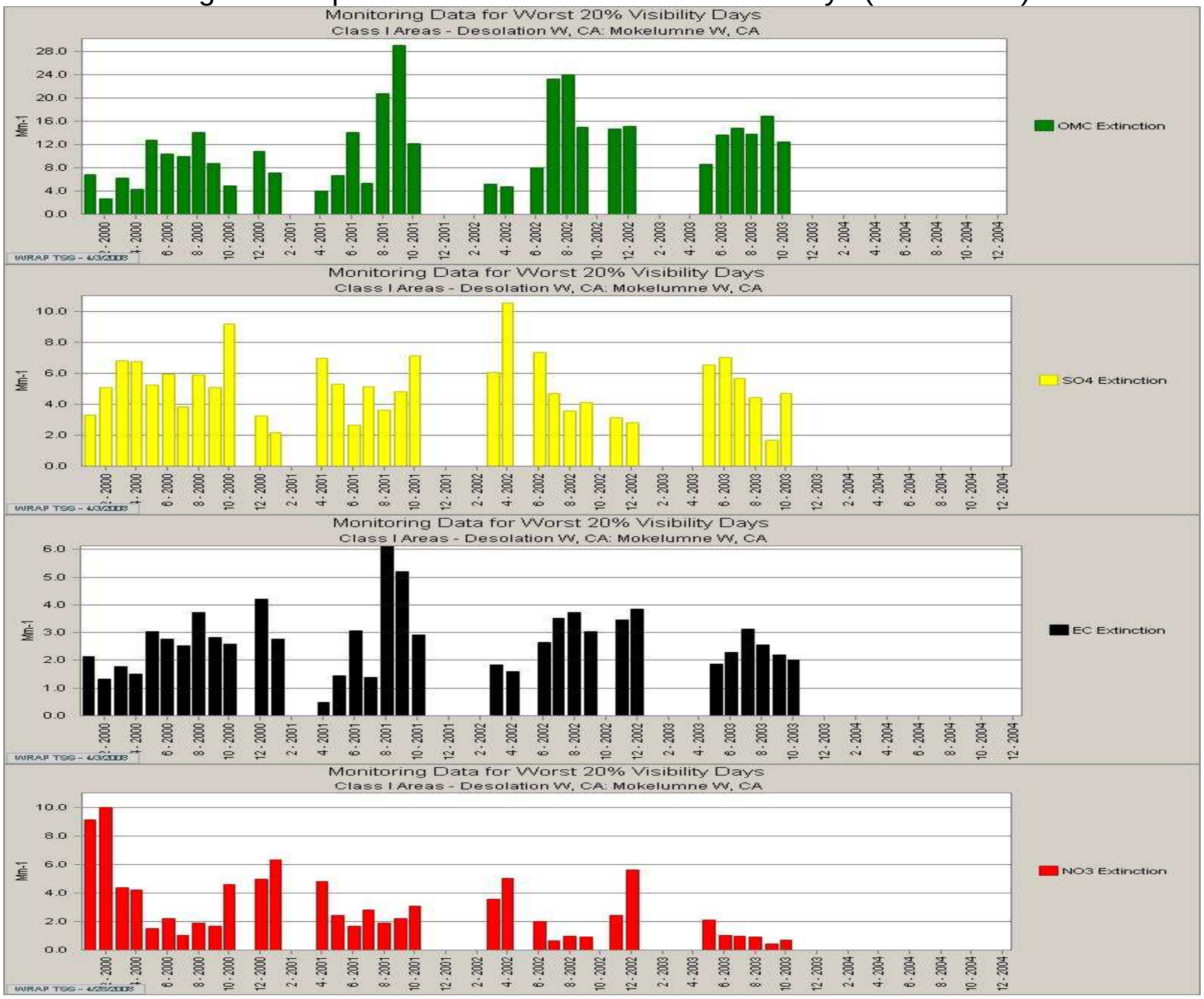


Figure 9. Species contribution on 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at BLIS1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 10 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the BLIS1 monitor is from natural fire sources within California. California represents 70% of all natural fire source contributions.

Figure 11 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 63% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 33% of the total organic carbon emissions and anthropogenic secondary emissions are responsible for the remaining emissions.

Figures 12 and 13 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at BLIS1. The Outside Domain region represents 41% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (39%) and the Pacific Offshore Region (13%). California contributes 20% of the total sulfate emissions seen at the BLIS1 monitor.

Individually, emissions from outside the modeling domain contribute the most sulfate concentrations at the BLIS1 monitor. The next largest contributor to sulfate concentration is area sources in the Pacific Offshore Region.

Figure 14 represents the elemental carbon source contribution from CA and outside regions. Natural fire occurrences within California contribute the highest concentration of elemental carbon at the BLIS1 monitor. California is responsible for 70% of the elemental carbon emissions from wild fires, followed by Nevada wild fire emissions (25%).

Figures 15 and 16 represent the regional contributions to nitrate on the 20% worst days in 2002 and 2018 at the BLIS1 monitor. The WRAP Region represents the largest contribution to nitrate in 2002 and 2018 (76%) followed by the Outside Domain Region (19%) and emissions from the Pacific Offshore (3%). In 2002, 57% of nitrate at the BLIS1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most nitrate concentrations at the AGT1 monitor in 2002 and 2018. Currently, California mobile sources are 72% of all California contributions at the AGT1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 10. Organic carbon source contribution from CA and outside regions

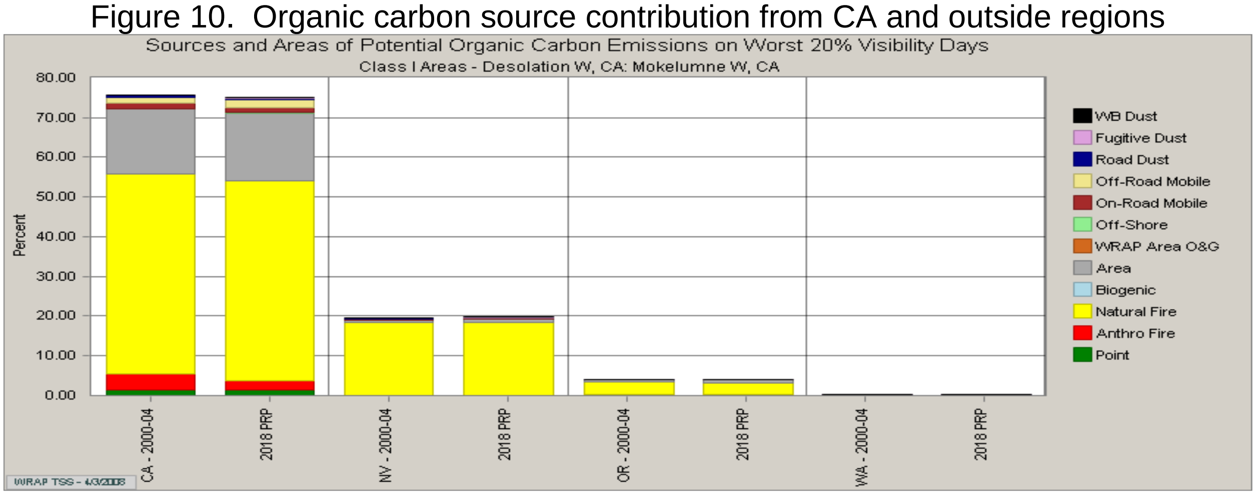


Figure 11. Organic carbon Anthropogenic and Biogenic Source Apportionment

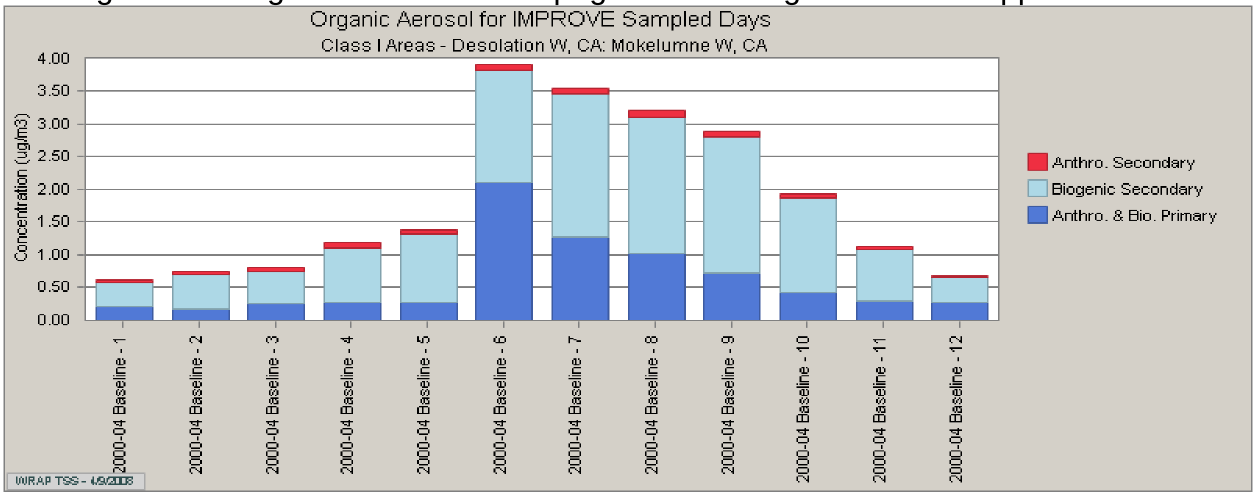


Figure 12. Regional Sulfate contribution to Haze in 2002 and 2018

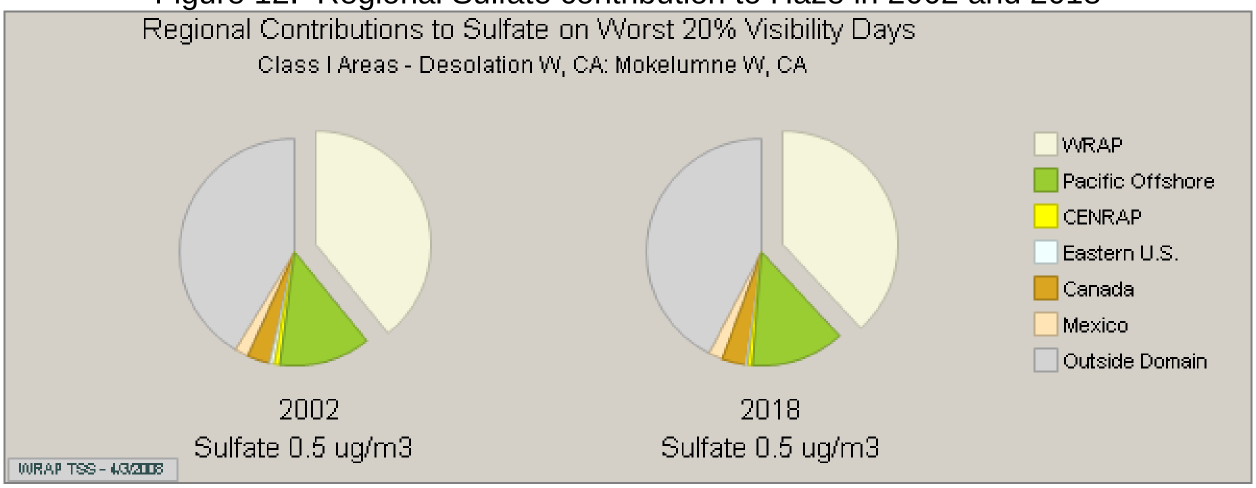


Figure 13. Sulfate source contribution from CA and outside regions

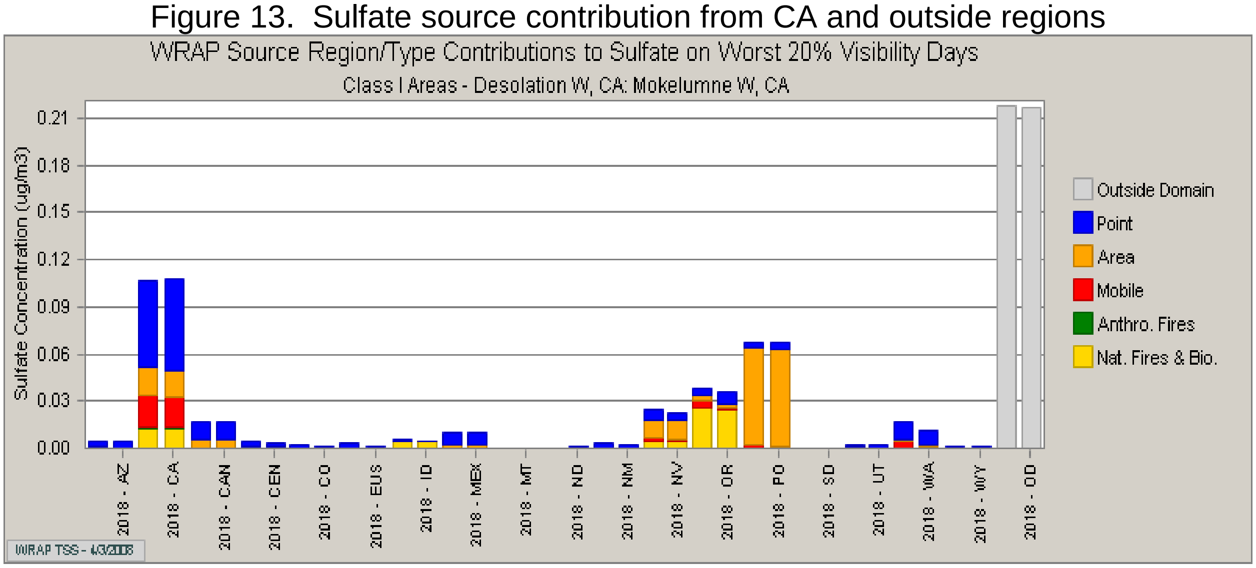


Figure 14. Elemental Carbon source contribution from CA and outside regions

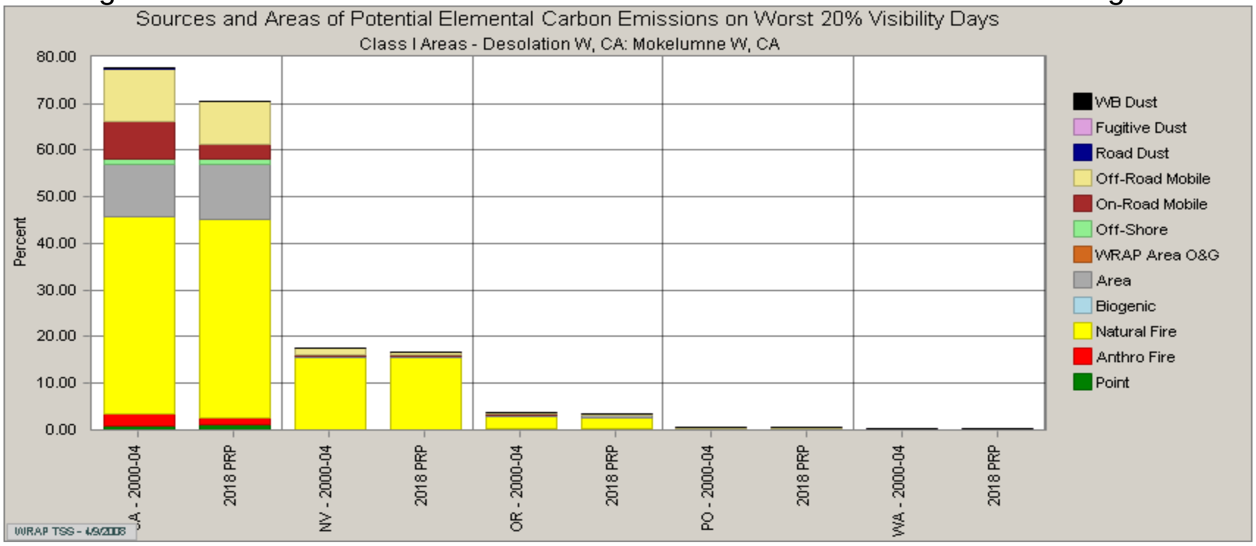


Figure 15. Regional Nitrate contribution to Haze in 2002 and 2018

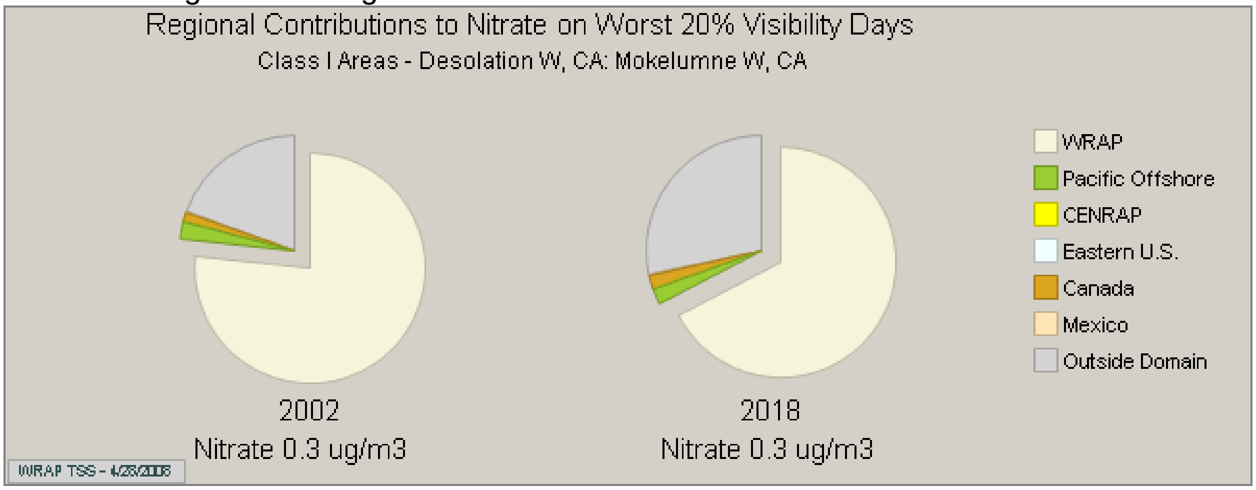
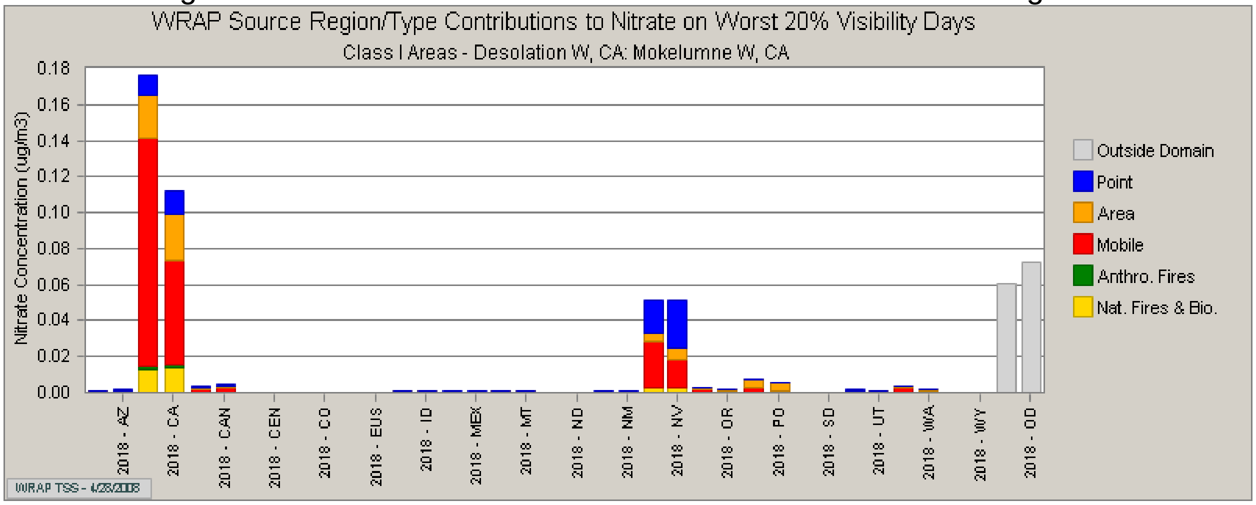


Figure 16. Nitrate source contribution from CA and outside regions



HOOV1 Monitor

Section I. Description

The Hoover Wilderness is an area of approximately 48,000 acres in the Sierra Nevada range, east of the crest and primarily in the rain shadow of the Sierra Nevada. It is located between Mono Lake and the eastern portion of Yosemite National Park. Elevations within the wilderness range from about 2,561 meters on lower slopes to over 3,658 meters on the crest. Streams flow eastward into Bridgeport Valley and Mono Valley from the northern Wilderness and into Mono Valley from the southern Wilderness. Mono Lake is a terminal lake with no outlet. Mono Lake and Owens Lake 93 miles to the south are major sources of windblown alkali dust that may impact visibility in the Wilderness.

Figure 1. HOOV1 Monitor location

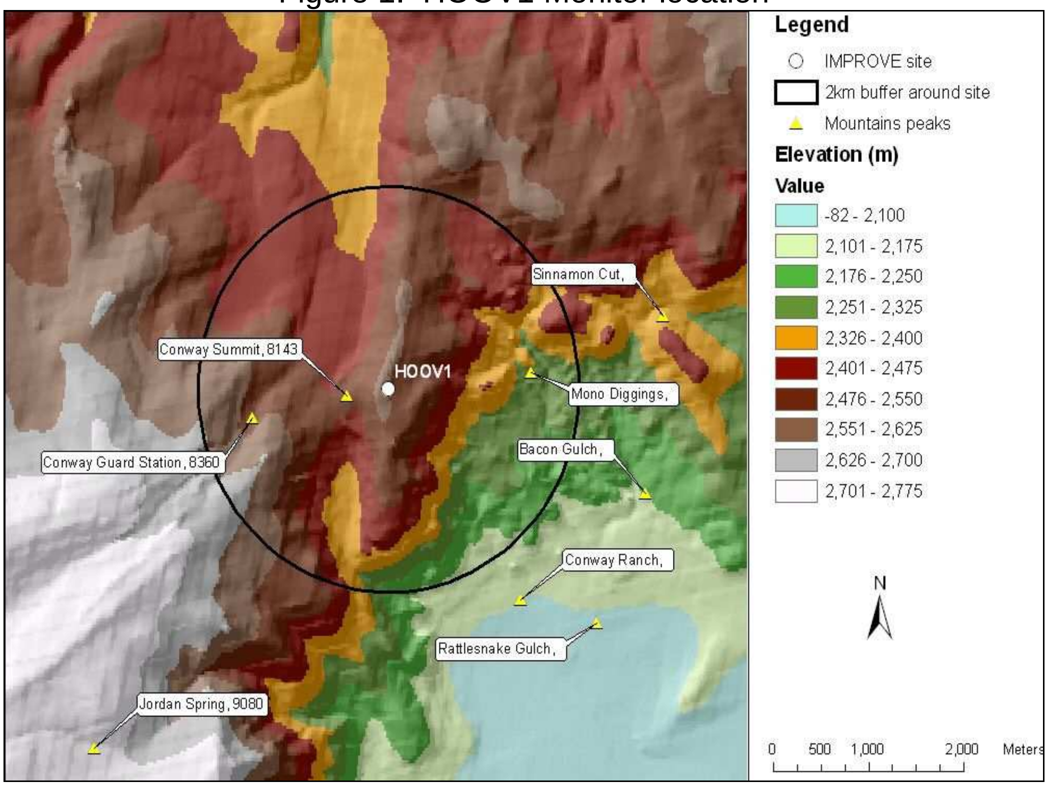


Figure 2. HOOV1 monitor location in California

Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for Hoover Wilderness are currently monitored by the HOOV1 IMPROVE monitor. The monitor is located at 38.0881 north latitude and 119.1771 west longitude in a well-exposed location with an unobstructed vista into the Hoover Wilderness to the west. The monitor elevation is near the lower end of the range of Wilderness elevation and is about 488 to 610 meters above the Bridgeport and Mono Valley floors. HOOV1 data should be generally representative of aerosol characteristics in the Hoover Wilderness. During episodes of windblown dust from the valley floors it should represent worst visibility conditions at the most impacted lower Wilderness elevations. The site has been operating since July 2001. This site does not have sufficient data for the entire baseline period. Data was not available for the years 2000 and 2001.

The Hoover Wilderness Area is on the east slopes of the Sierra Nevada, adjacent to Mono and Bridgeport Valleys. Mono Lake and Owens Lake 93 miles to the south are potential sources of alkali dust from these desiccated lake beds. Dust from these sources can be transported larger distances because it is unusually fine-grained compared to dust from other natural sources. The largest anthropogenic source region is the Central Valley, which could be a source of aerosols mixed upwards and transported across the Sierra Nevada crest by prevailing westerly winds.

The HOOVI location is adequate for assessing the 2018 reasonable progress goals for the Hoover Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from HOOV1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the Hoover Wilderness Area is calculated at 1.4 deciviews for the 20% best days and 12.9 deciviews for the 20% worst days. Figure 3 represents the worst baseline visibility conditions.

II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the Hoover Wilderness Area is 0.1 deciviews for the 20% best days and 7.7 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 3 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 11.66 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 1.4 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 3. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)

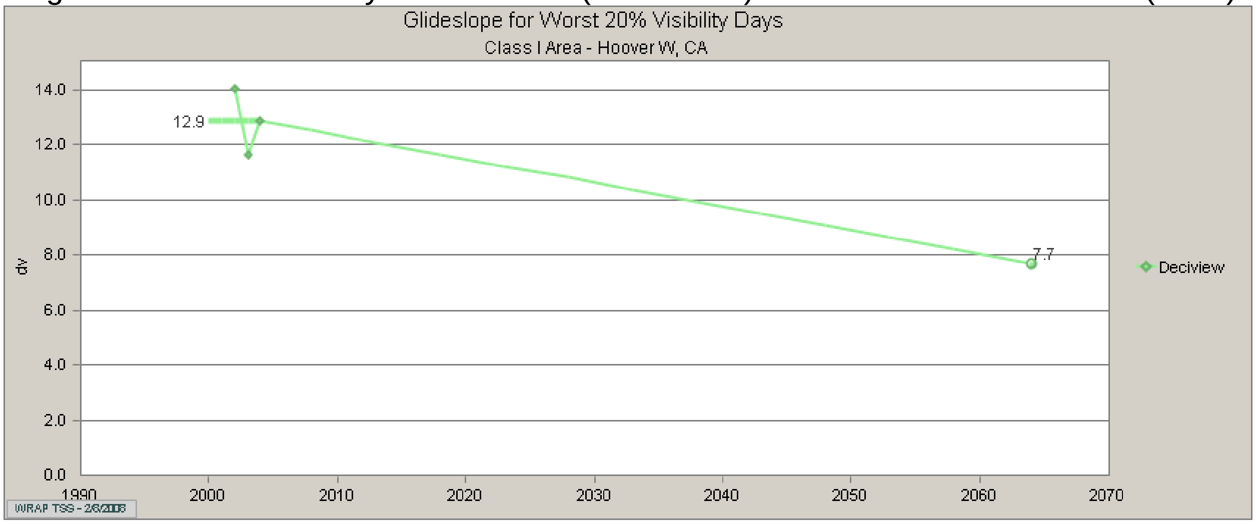


Figure 4. WINHAZE image of Hoover Wilderness Area (1.4 vs. 12.9 deciviews)

II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at HOOV1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

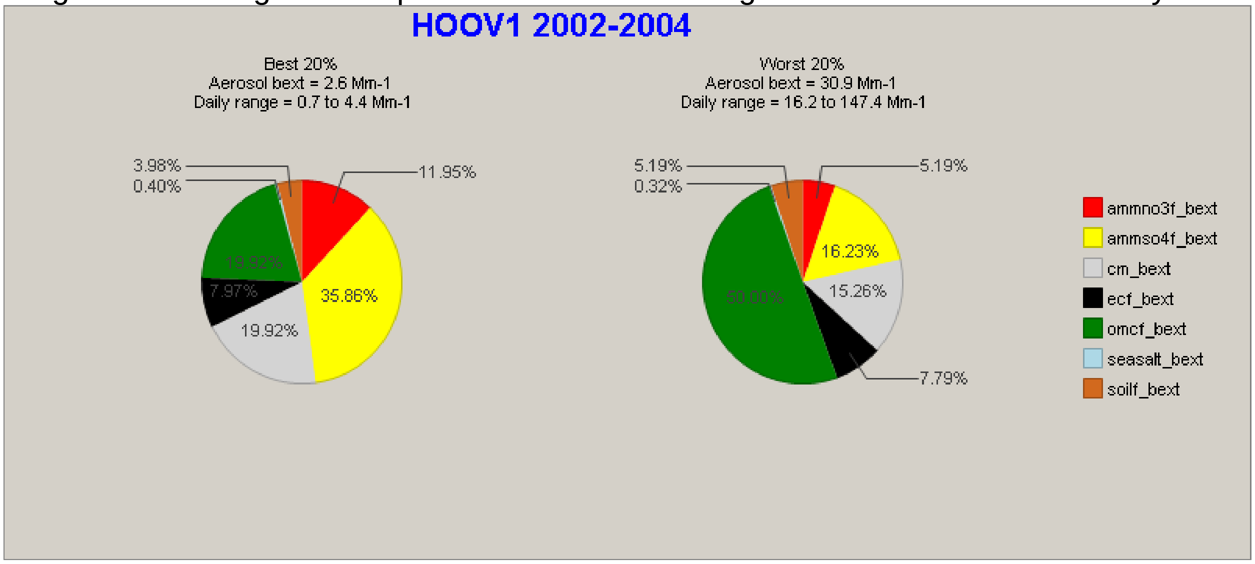
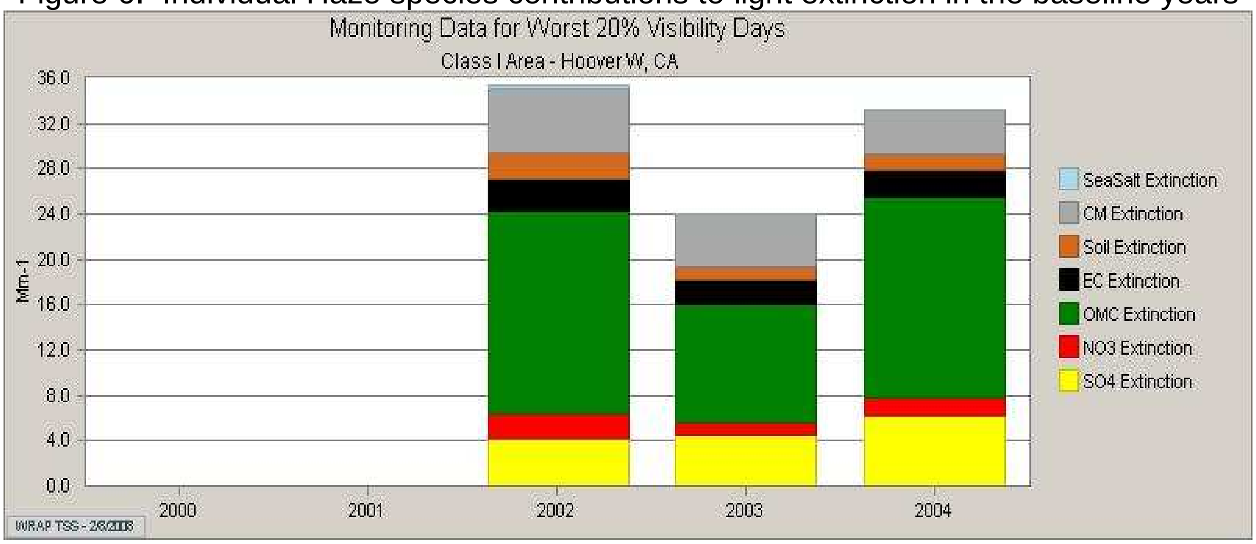


Figure 6. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, organic matter, sulfates, and coarse mass have the strongest contributions to degrading visibility on worst days at Hoover Wilderness Area. The worst days are dominated by organic matter, while the best days are dominated by sulfates. Data points for 2000 and 2001 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 7 depicts the individual species contribution to worst days in 2002. Organic matter is seen to increase in the summer and winter. Sulfates increase in the late winter and early spring months. Coarse mass is not very predictable but does increase in the month of February. Organic matter clearly dominates the other haze species on worst days, but sulfate, nitrate, elemental carbon, coarse mass, and soil also contribute to worst days throughout the years. There are only trace amounts of sea salt present at this monitor.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for organic matter, sulfates, coarse mass, and nitrates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2002

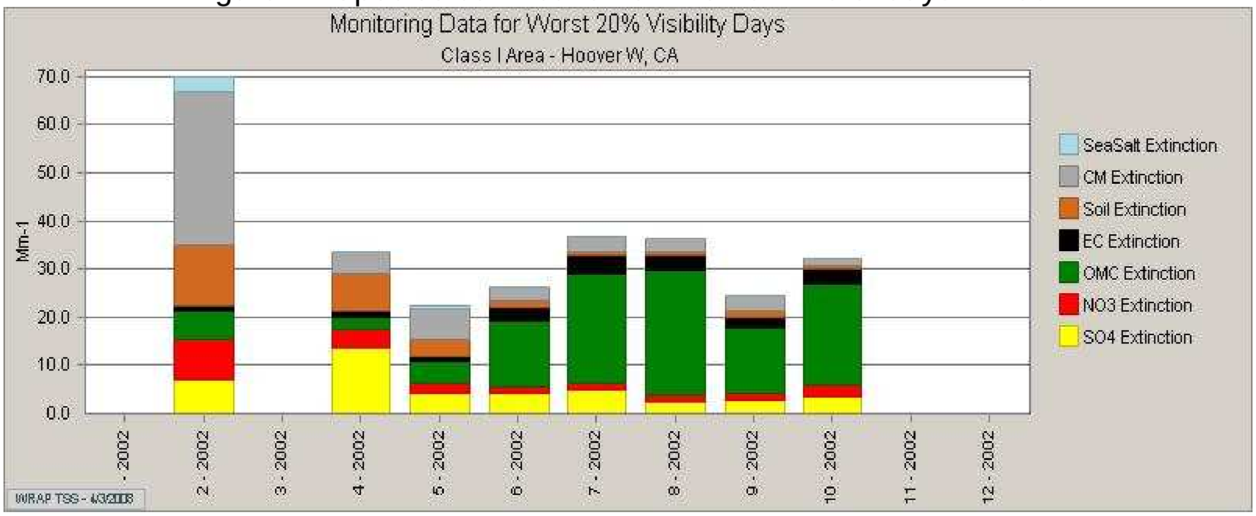
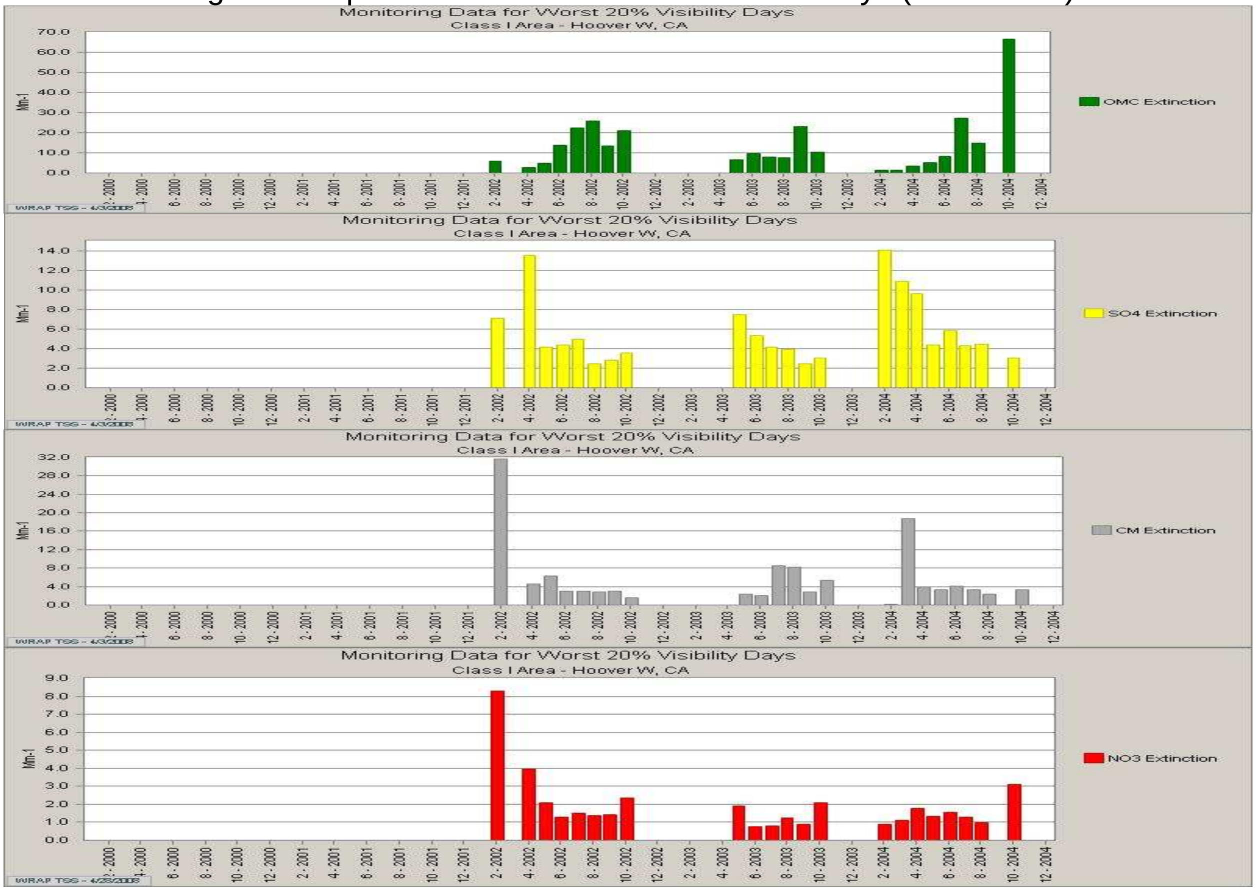


Figure 8. Species contribution on 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at HOOV1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 9 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the HOOV1 monitor is from natural fire sources within California. California represents 86% of all natural fire source contributions.

Figure 10 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 63% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 33% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 11 and 12 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at HOOV1. The Outside Domain region represents 45% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (35%) and the Pacific Offshore Region (12%). California contributes 19% of the total sulfate emissions seen at the HOOV1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the HOOV1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore Region.

Figure 13 shows the coarse mass source contribution from California and the outside regions. The largest contributor to coarse mass at the HOOV1 monitor is from road dust within California. California represents 95% of all road dust source contributions.

Figures 14 and 15 represent the regional contributions to nitrates on the 20% worst days at the HOOV1 monitor. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (68%), followed by the Outside Domain Region (27%) and emissions from Pacific Offshore (4%). Mobile sources within California contribute the most nitrates at the DOME1 monitor. In 2002, 52% of the nitrate at the HOOV1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most to nitrate concentrations at the HOOV1 monitor in 2002 and 2018. Currently, California mobile sources are 73% of California contributions to nitrate at the DOME1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 9. Organic carbon source contribution from CA and outside regions

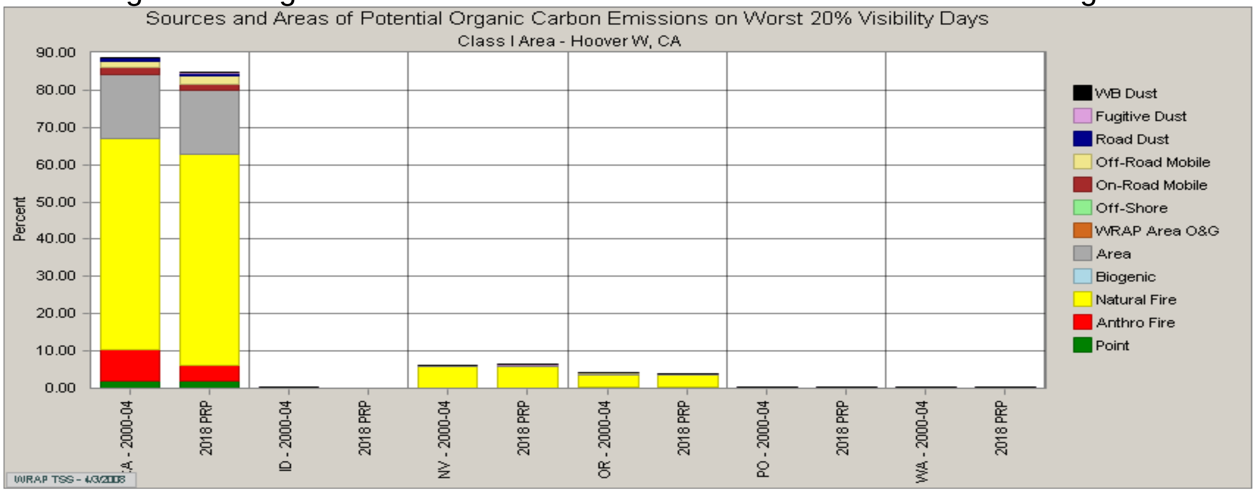


Figure 10. Organic carbon Anthropogenic and Biogenic Source Apportionment

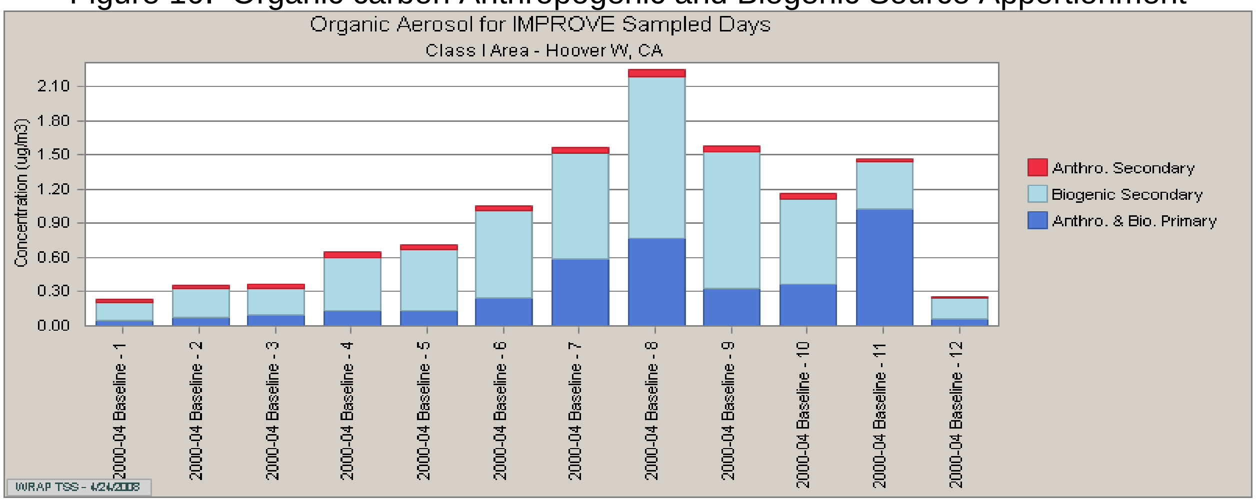


Figure 11. Regional Sulfate contribution to Haze in 2002 and 2018

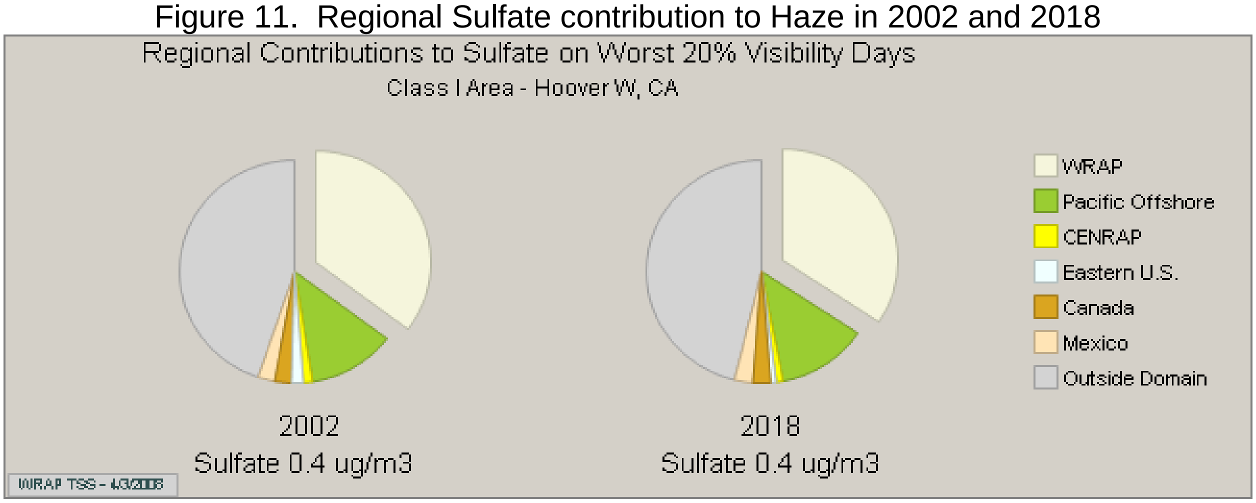


Figure 12. Sulfate source contribution from CA and outside regions

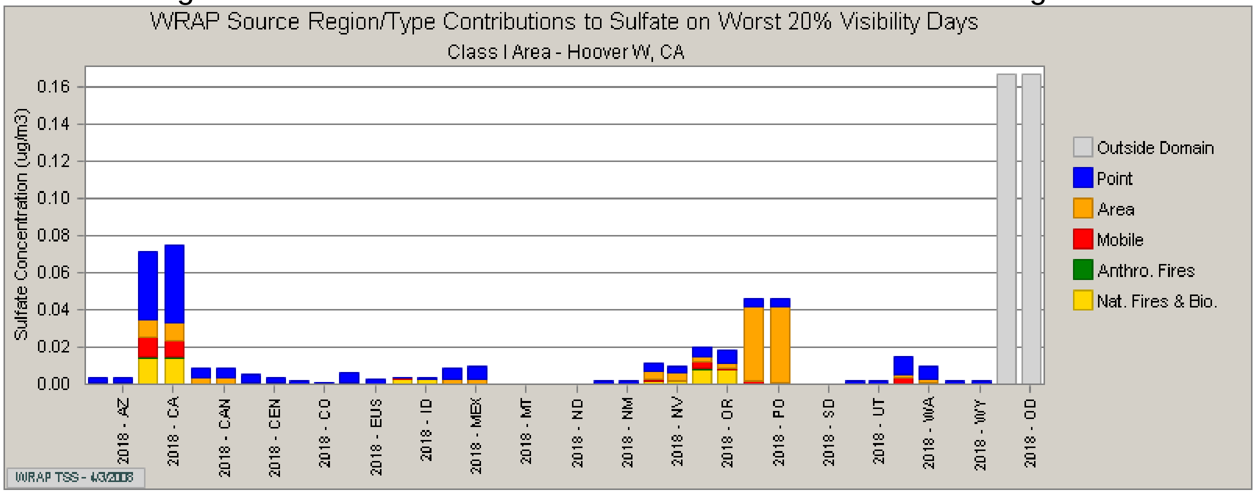


Figure 13. Coarse mass source contribution from CA and outside regions

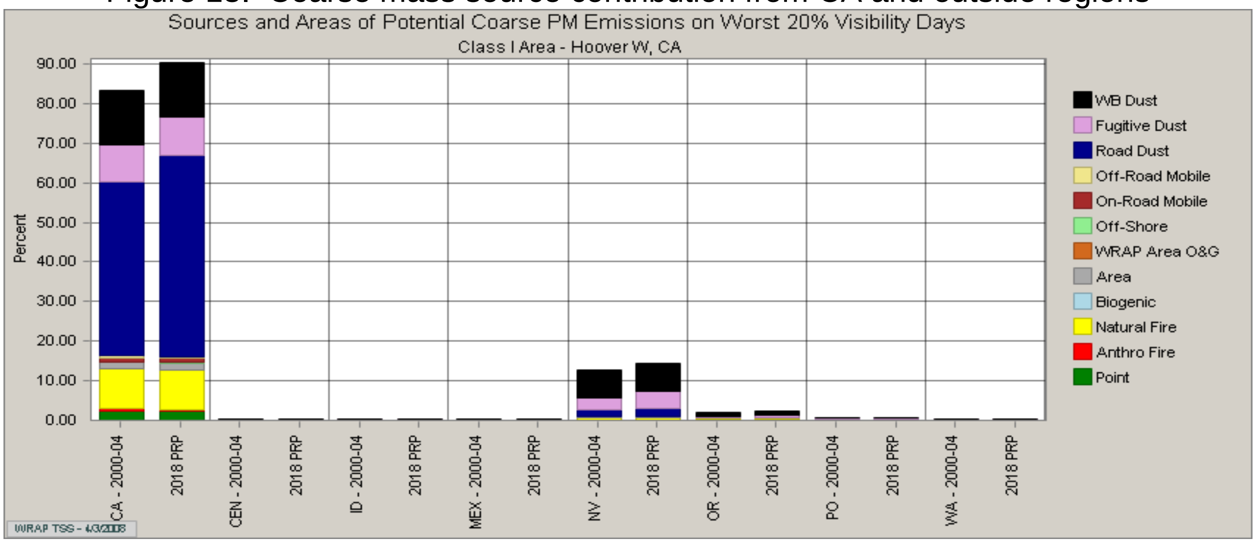


Figure 14. Regional Nitrate contribution to Haze in 2002 and 2018

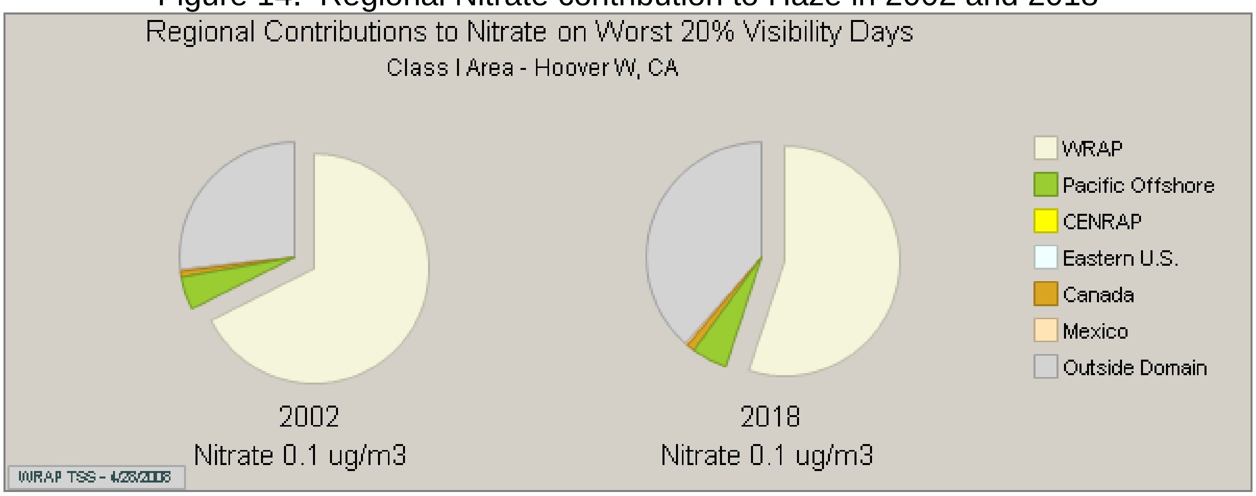
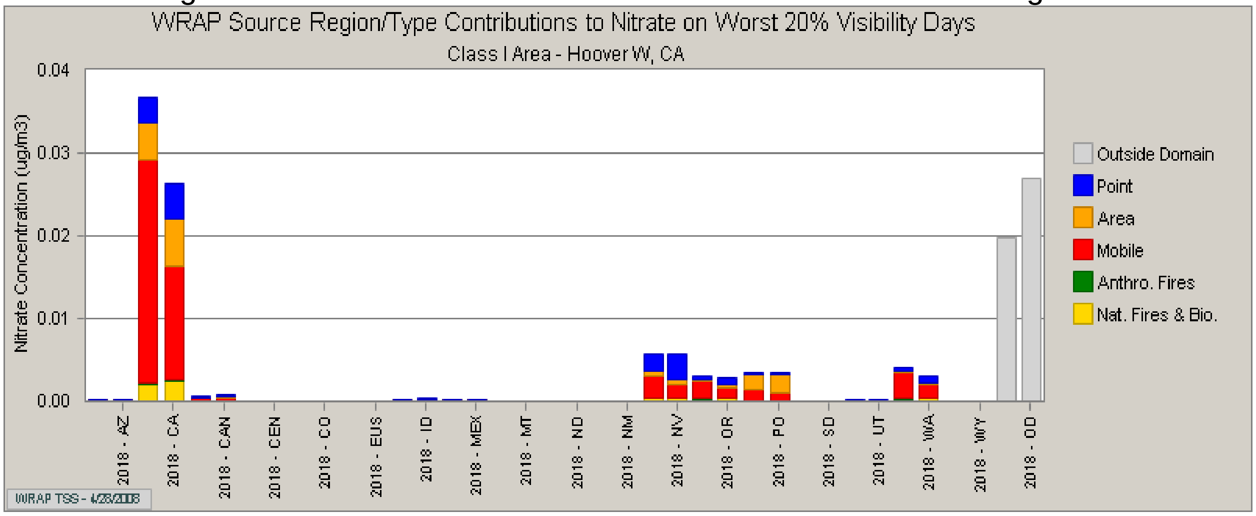


Figure 15. Nitrate source contribution from CA and outside regions



YOSE1 Monitor

The YOSE1 monitor location represents two wilderness areas located in the central Sierra Nevada Range. The wilderness areas associated with the YOSE1 monitor are Emigrant Wilderness Area and Yosemite National Park. The site has been operating since March 1988. The monitor has sufficient data for the five baseline years of 2000 – 2004.

Section I. YOSE1 Wilderness Area Descriptions

I.a. Emigrant Wilderness Area

The Emigrant Wilderness Area consists of 113,000 acres on the upper western slope of the central Sierra Nevada Range. It is bordered by Yosemite National Park on the south. Watersheds drain to the Stanislaus via the south Fork of the Stanislaus in the northern Wilderness, and the Tuolumne River via Cherry Creek in the southern Wilderness. The Stanislaus and Tuolumne Rivers flow southwest and open up into the San Joaquin Valley about 30 miles southwest of the Wilderness boundary. The central San Joaquin Valley area is the nearest major source region for anthropogenic emissions that could affect visibility in the Wilderness. Wilderness elevations range from about 1,524 meters at Cherry Reservoir to 3,527 meters at Leavitt Peak on the Sierra Nevada crest.

Figure 1. Emigrant Wilderness Area

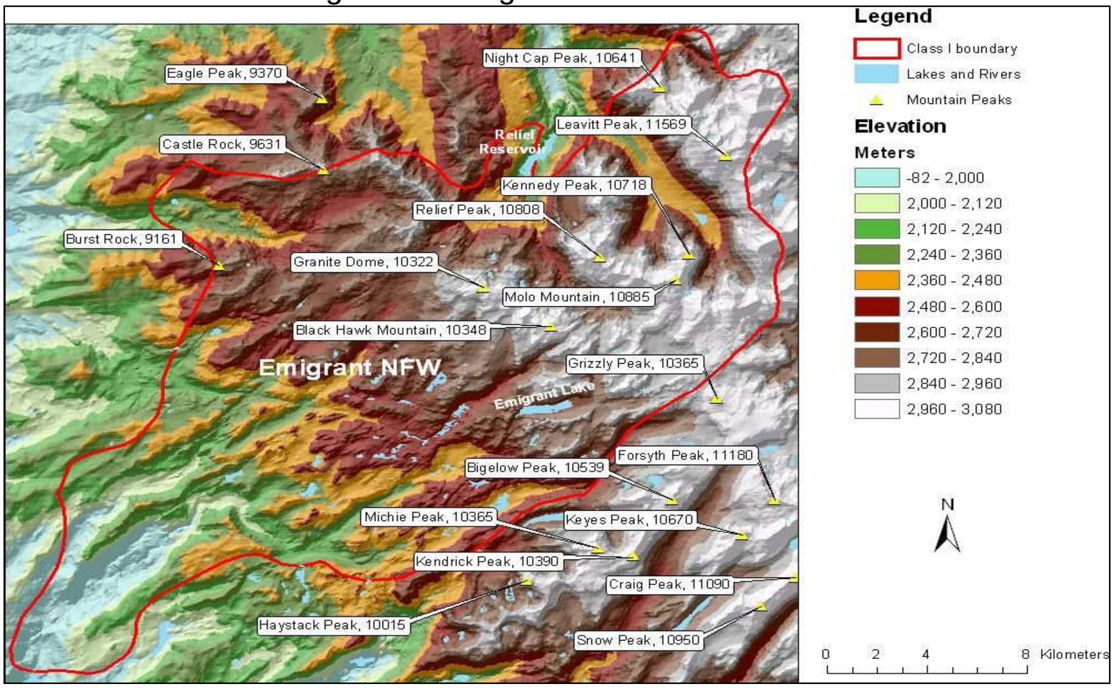


Figure 2. WINHAZE image of Emigrant Wilderness Area (3.4 vs. 17.6 dv)

I.b. Yosemite National Park

Yosemite National Park (Yosemite) consists of approximately 750,000 acres in the central Sierra Nevada range, west of the crest. It includes headwaters of the Tuolumne River in the north, and the Merced River to the south. The Tuolumne and Merced Rivers flow west and open up into the San Joaquin Valley about 20 miles west of the Yosemite boundary. The central San Joaquin Valley is the nearest major source region for anthropogenic emissions that could affect visibility in Yosemite. Park elevations range from about 600 meters where the Tuolumne River exits the Park and 1,000 meters where the Merced River exits the Park, to up to 4,000 meters at the Sierra Nevada crest which forms the Park's eastern boundary. Lowest elevations are 457 meters or more above the San Joaquin Valley floor. The Tuolumne and Merced Rivers form steep canyons, the Grand Canyon of the Tuolumne River and Yosemite Valley, respectively, and are oriented east to west in the heart of Yosemite.

Figure 3. YOSE1 Monitor location

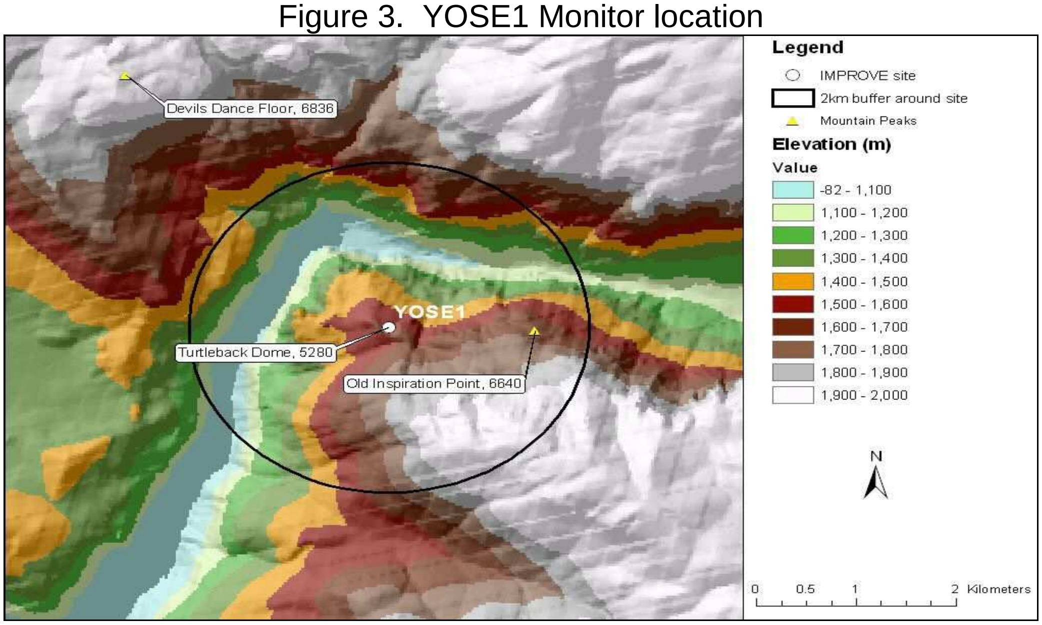
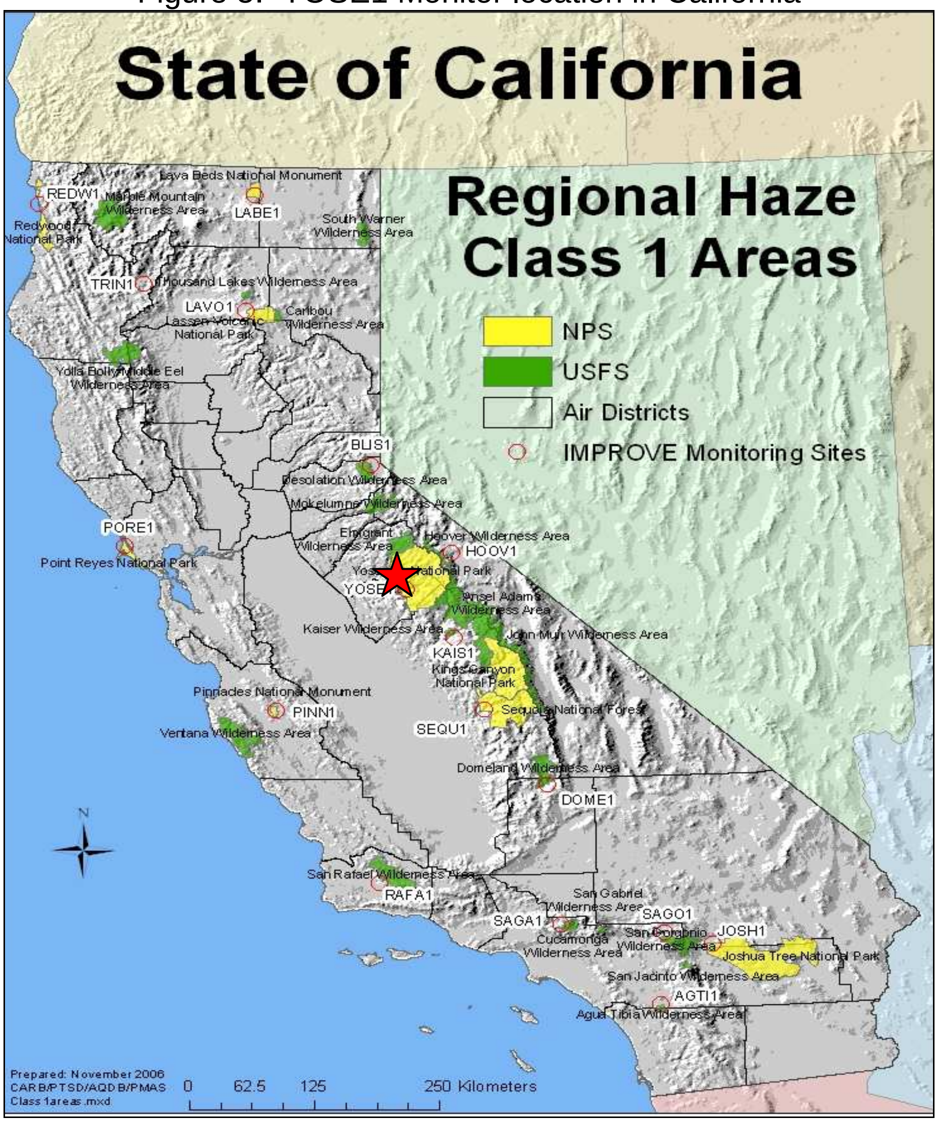


Figure 4. WINHAZE image of Yosemite National Park (3.4 vs. 17.6 deciviews)

Figure 5. YOSE1 Monitor location in California



Section II. Visibility Conditions:

II.a. Emigrant Wilderness Area

Visibility conditions for the Emigrant Wilderness are currently monitored by the YOSE1 IMPROVE monitor in Yosemite National Park. The monitor is located at 37.7133 north latitude and 119.7061 west longitude near the west end of Yosemite Valley at an elevation of 1,603 meters.

The lowest elevations in Emigrant Wilderness are higher than the lowest Yosemite Park elevations, but are still near the YOSE1 elevation. Data from YOSE1 should be representative of aerosol concentrations and composition in the Merced and Tuolumne River areas of central Yosemite National Park and in the upper Stanislaus River area of the Emigrant Wilderness Area, except when the areas are influenced by different local sources such as wild land fires. The nearest major population center and source region for emissions that could contribute to haze in the Emigrant Wilderness and measured at YOSE1 is the San Joaquin Valley, 30 miles west of the western park boundary.

The YOSE1 location is adequate for assessing the 2018 reasonable progress goals for the Emigrant Wilderness Class 1 area.

II.b. Yosemite National Park

Visibility conditions for Yosemite are currently monitored by the YOSE1 IMPROVE monitor. The monitor is located at 37.7133 north latitude and 119.7061 west longitude near the west end of Yosemite Valley at an elevation of 1,603 meters.

Data from YOSE1 should be representative of aerosol concentration and composition in the Yosemite Valley and Merced River areas of central Yosemite National Park. It should also be representative of the Tuolumne River area except when the two areas are influenced by different local sources such as wildland fires. YOSE1 is at an elevation of 1,603 meters, 300 to 400 meters above the canyon floor, so there could be times when canyon bottom locations are within a surface inversion that does not extend upward to the monitoring site elevation. The nearest major population center and source region for emissions that could contribute to haze measured at YOSE1 is the San Joaquin Valley, 20 miles west of the western Park boundary to which it is linked by the Tuolumne and Merced River valleys.

The YOSE1 location is adequate for assessing the 2018 reasonable progress goals for the Yosemite National Park Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from YOSE1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the YOSE1 monitor is calculated at 3.4 deciviews for the 20% best days and 17.6

deciviews for the 20% worst days. Figure 6 represents the worst baseline visibility conditions.

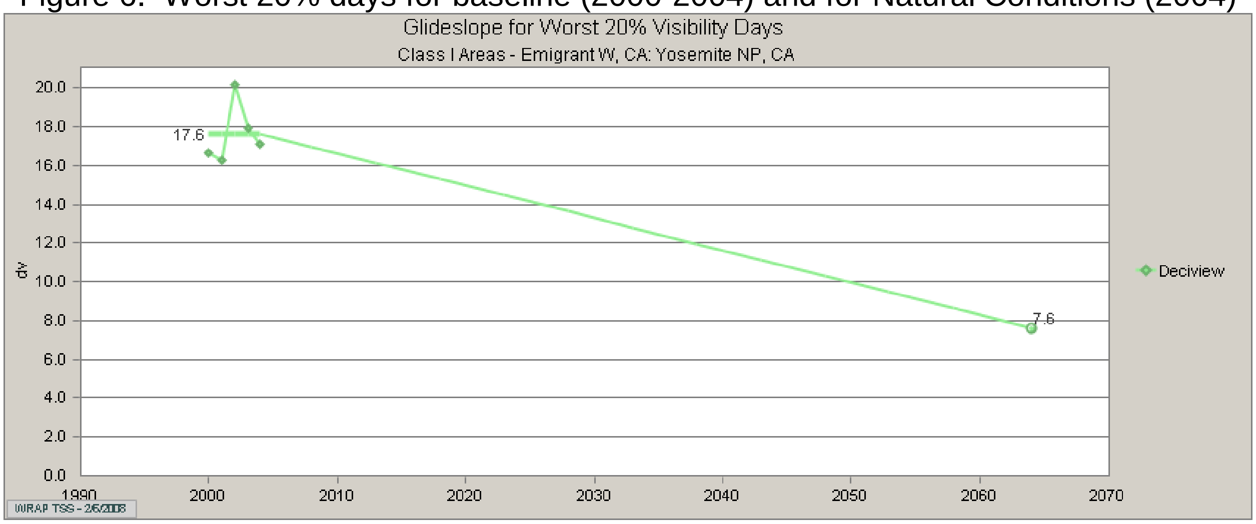
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the YOSE1 monitor is 1.0 deciviews for the 20% best days and 7.6 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 6 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 15.30 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 3.4 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 6. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 7 shows the contribution of each species to the 20% best and worst days in the baseline years at YOSE1.

Figure 7. Average Haze species contributions to light extinction in the baseline years

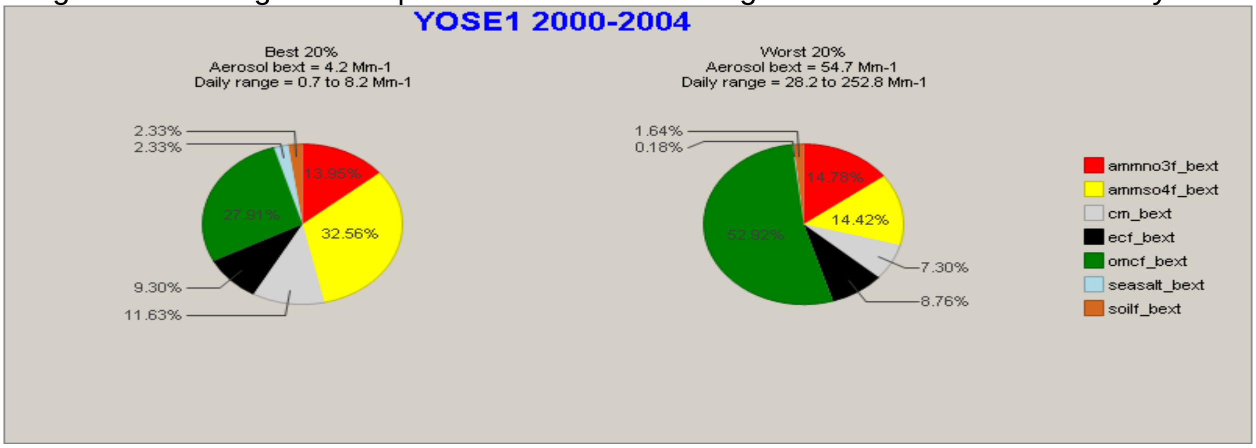
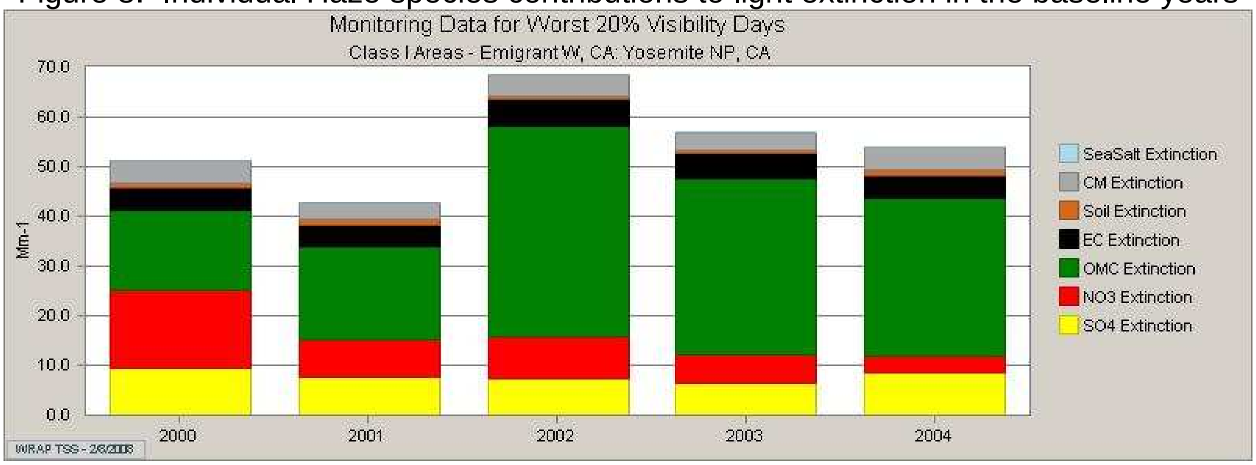


Figure 8. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 7 and 8, organic matter, nitrates, and sulfates have the strongest contributions to degrading visibility on worst days at the YOSE1 monitor. The worst days are dominated by organic matter, while the best days are dominated by sulfate. The monitor has sufficient data for the five baseline years of 2000 – 2004.

Figure 9 depicts the individual species contribution to worst days in 2002. Organic matter increases in the fall and winter and nitrates increase in the winter months. Sulfates remain relatively stable throughout the year but do see a slight increase in the summer. Organic matter clearly dominates the other haze species on worst days but nitrates, sulfates, elemental carbon, and coarse mass also contribute to the worst days throughout the year. There are only trace amounts of soil and sea salt present at this monitor.

Figure 10 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 9 for organic matter, nitrates, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 9. Species contribution on the 20% worst days in 2002

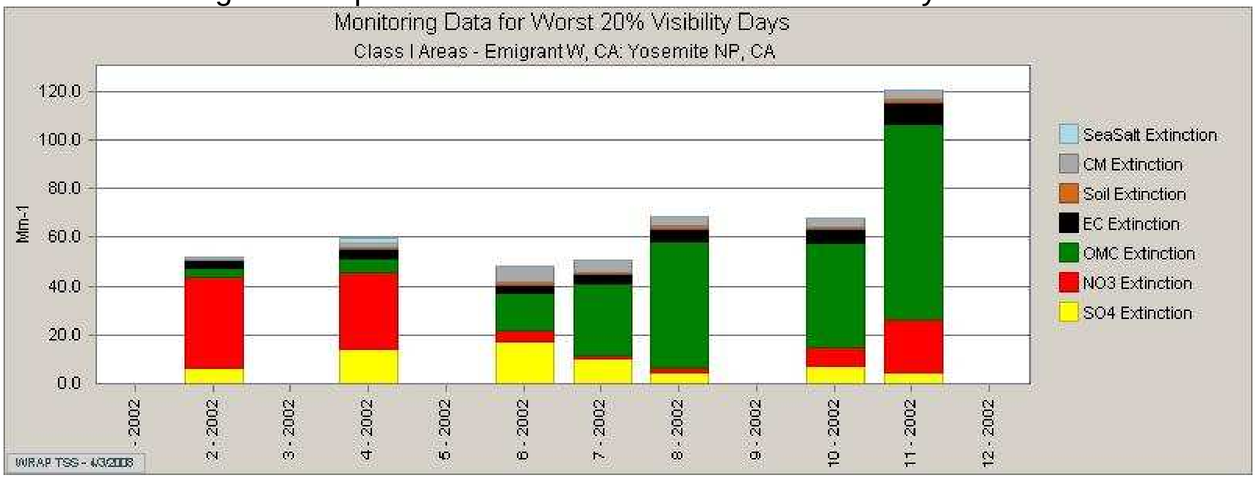
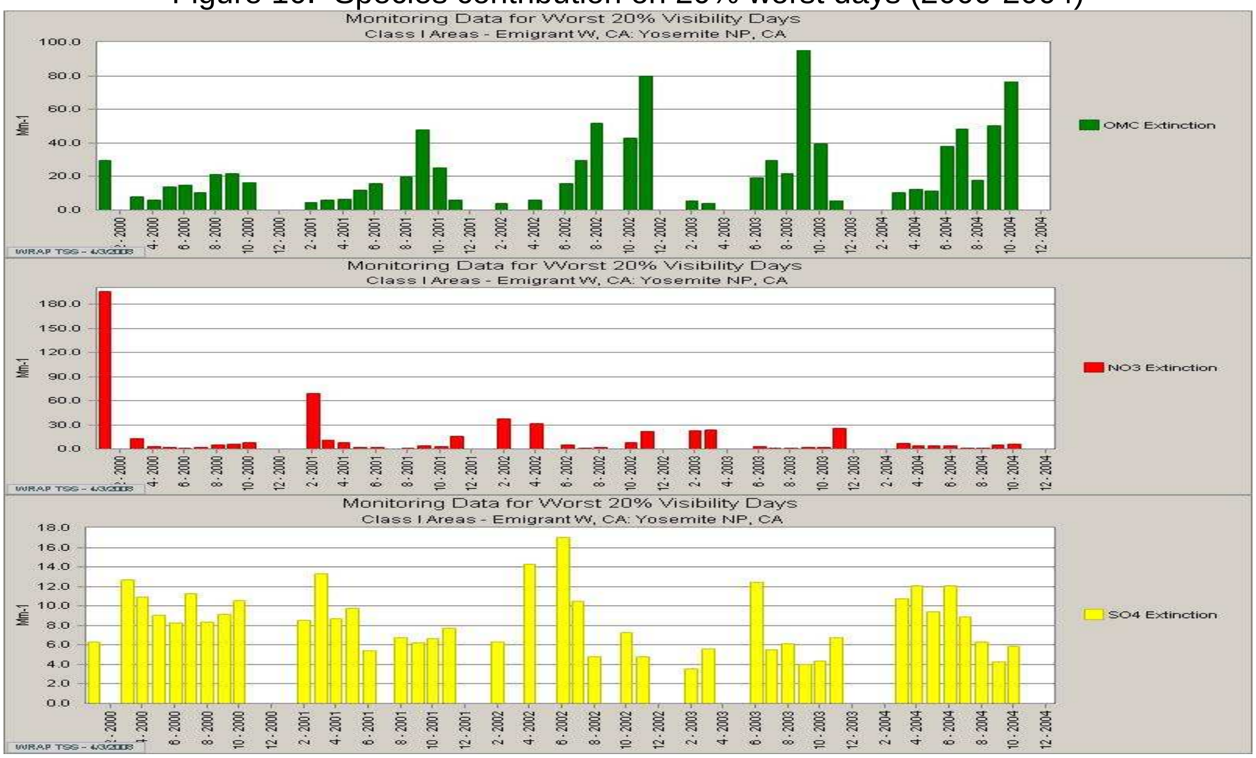


Figure 10. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at YOSE1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 11 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the YOSE1 monitor is from natural fire sources within California. California represents 88% of all natural fire source contributions.

Figure 12 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 60% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 36% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 13 and 14 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (78%), followed by the Outside Domain Region (17%) and emissions from Pacific Offshore (5%). Mobile sources within California contribute the most nitrates at the YOSE1 monitor. In 2002, 87% of the nitrate from mobile sources at the YOSE1 monitor can be attributed to California. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figures 15 and 16 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at the YOSE1 monitor. The Outside Domain region represents 43% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (36%) and the Pacific Offshore Region (15%). California contributes 22% of the total sulfate emissions seen at the YOSE1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the YOSE1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore.

Figure 11. Organic carbon source contribution from CA and outside regions

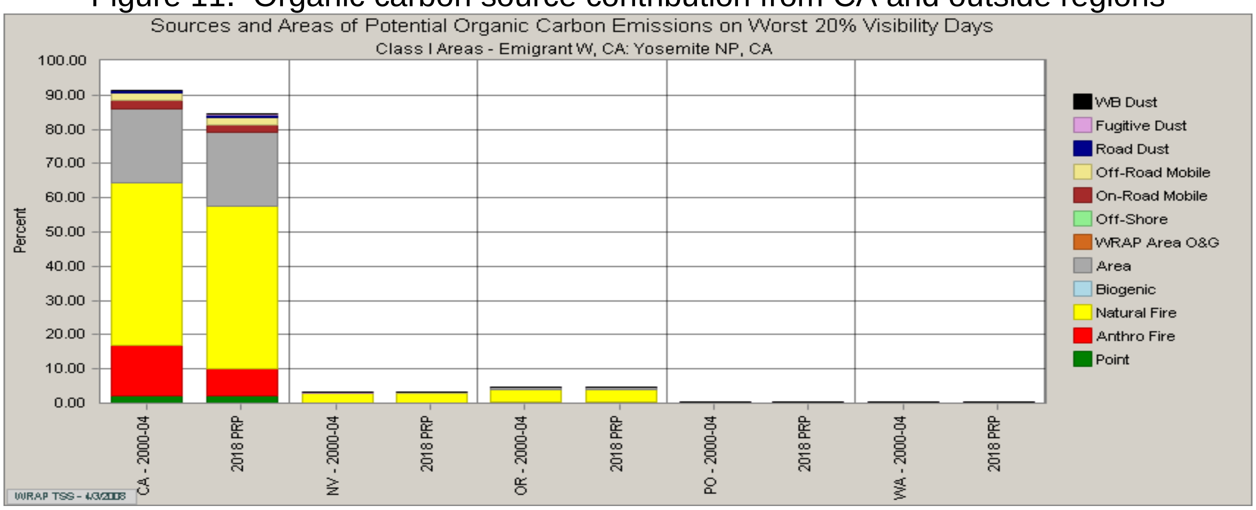


Figure 12. Organic Carbon Anthropogenic and Biogenic Source Apportionment

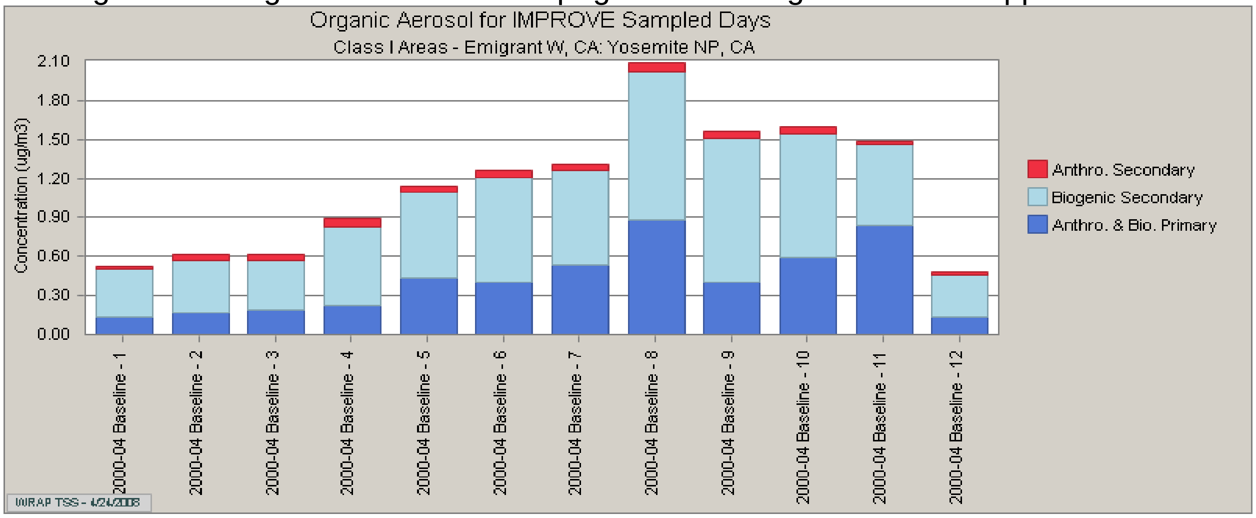


Figure 13. Regional Nitrate contribution to Haze in 2002 and 2018

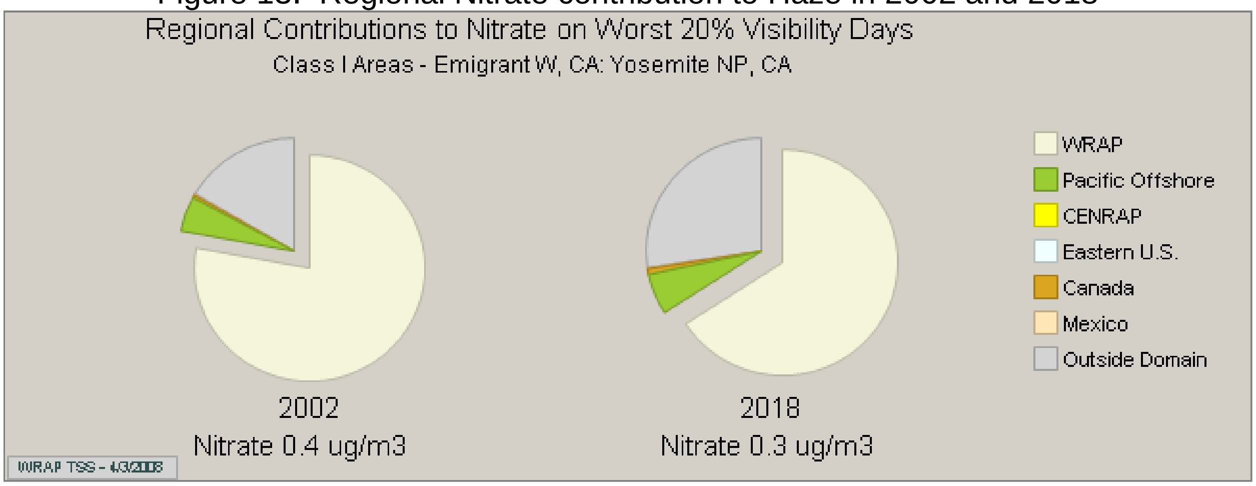


Figure 14. Nitrate source contribution from CA and outside regions

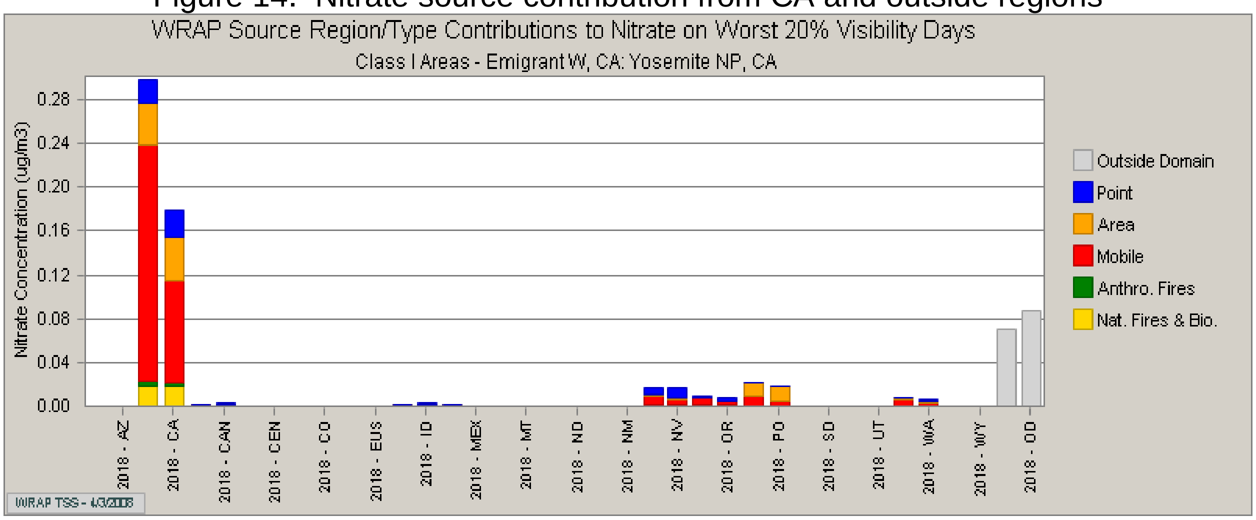


Figure 15. Regional Sulfate contribution to Haze in 2002 and 2018

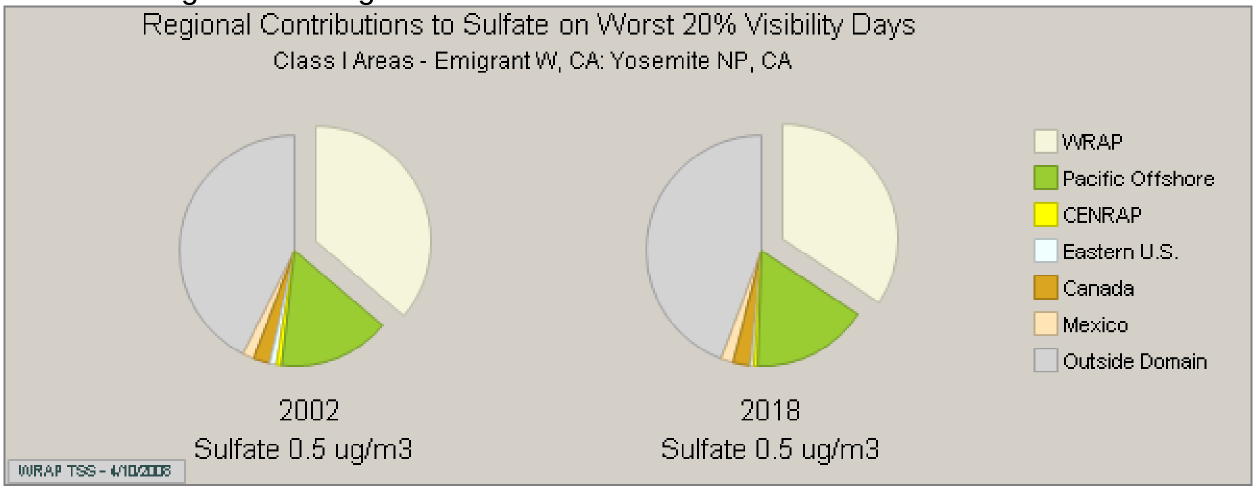
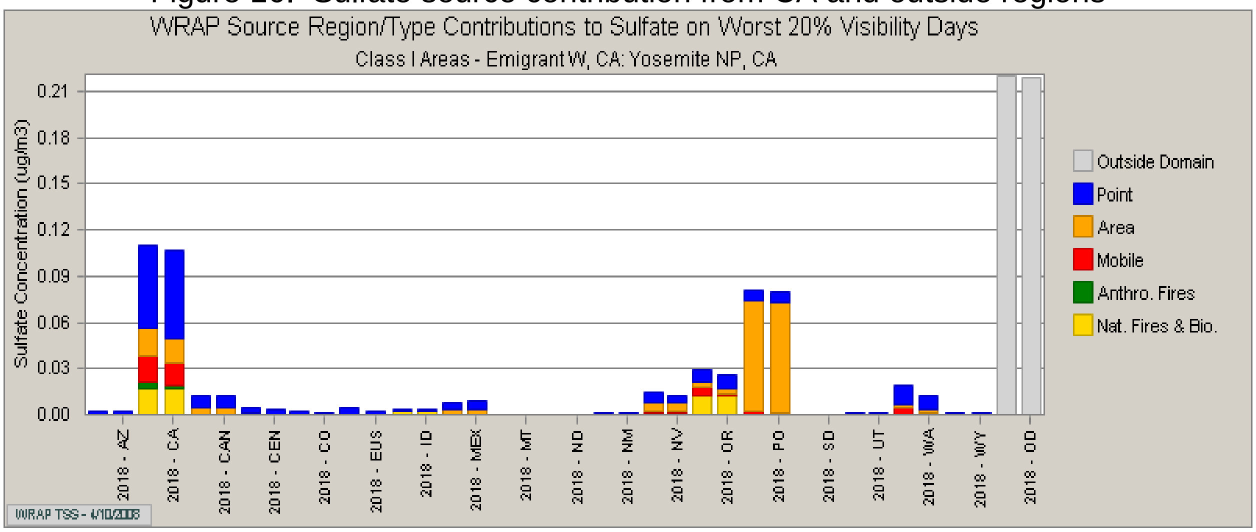


Figure 16. Sulfate source contribution from CA and outside regions



KAIS1 Monitor

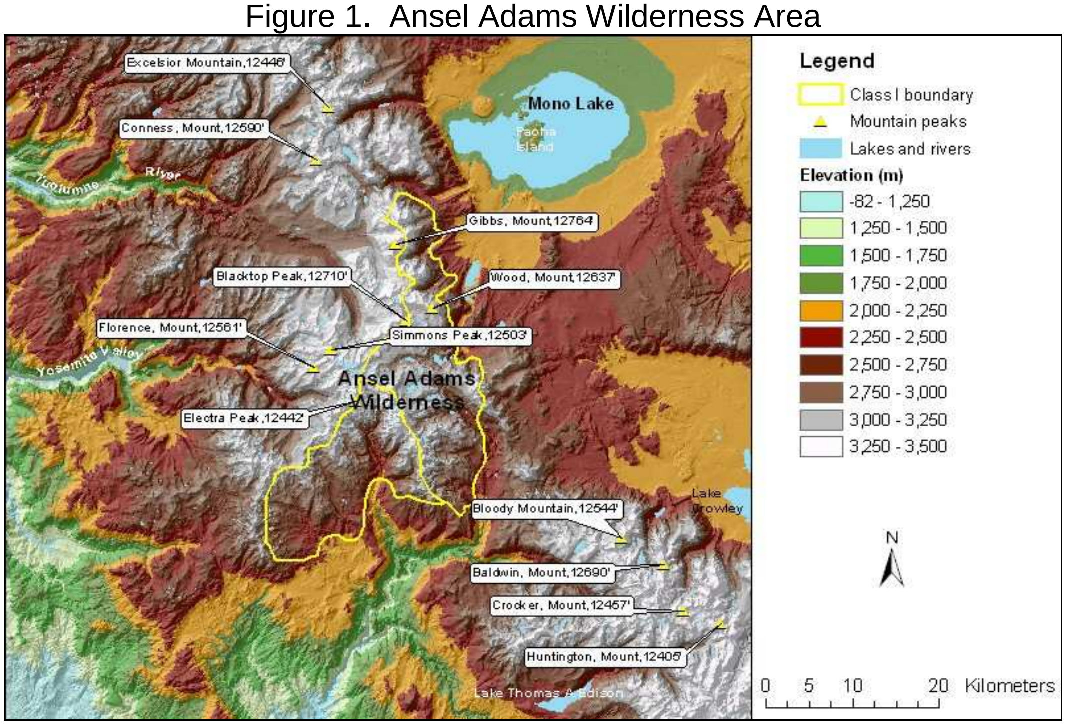
The KAIS1 monitor location represents three wilderness areas within the Sierra Nevada mountain range. The wilderness areas associated with the KAIS1 monitor are Ansel Adams Wilderness area, John Muir Wilderness area, and Kaiser Wilderness area. The KAIS1 site has been in operation since January of 2000. This site does not have sufficient data for the entire baseline period. Data was not available for the years 2000 and 2001.

<u>Section I. KAIS1 Wilderness Area Descriptions</u>

I.a. Ansel Adams Wilderness Area

The Ansel Adams Wilderness Area formerly known as the Minarets Wilderness, is located in both the Sierra and Inyo National Forests and covers approximately 228,500 acres (138,660 acres are in Sierra National Forest). Ansel Adams is characterized by spectacular alpine scenery with barren granite peaks, steep-walled gorges and rock outcroppings. Elevations range from 1,067 meters to 4,010 meters and there are several small glaciers on the north and northeast facing slopes of the highest peaks. There are also a number of fairly large lakes on the eastern slope of the precipitous Ritter Range. The Ansel Adams Wilderness contains the headwaters of the North and Middle Forks of the San Joaquin River. The San Joaquin River flows south and west from the Wilderness and eventually opens up into the San Joaquin Valley 20 to 25 miles west of the Wilderness and just north of Fresno. This central San Joaquin Valley area is the nearest major source region for anthropogenic emissions that could affect visibility in the Wilderness.

Figure 1. Ansel Adams Wilderness Area

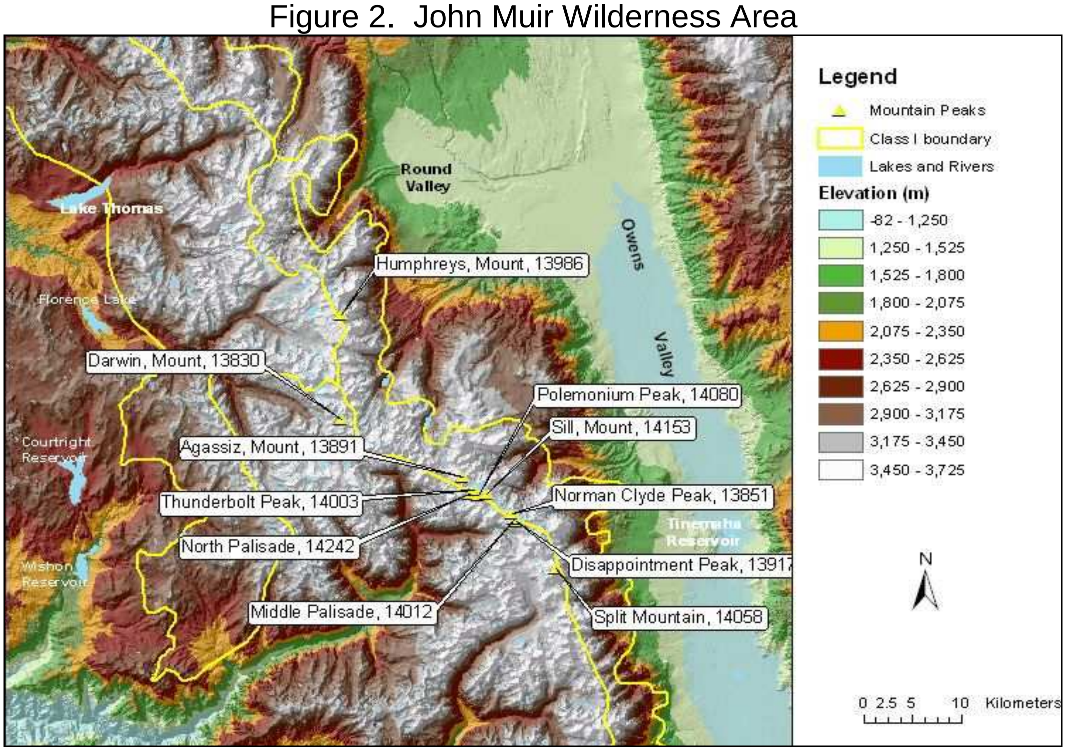


I.b. John Muir Wilderness Area

The John Muir Wilderness Area consists of 581,000 acres, and extends for 100 miles along the crest and on both sides of the Sierra Nevada in the Inyo and Sierra National Forests. The wilderness extends from Reds Meadow (near Mammoth Mountain) in the north, to south of Mount Whitney. The wilderness area also spans the Sierra north of Kings Canyon National Park, and extends in the west side of the park down to the Monarch Wilderness. West of the crest, it includes the headwaters of the South and Middle Forks of the San Joaquin River and the North Fork of the Kings River. The San Joaquin and Kings rivers flow westward into the San Joaquin Valley, about 30 miles west of the western wilderness boundary. The wilderness contains the most spectacular and highest peaks of the Sierra Nevada. The peaks are typically made of granite from the Sierra Nevada batholiths and are dramatically shaped by glacial action. The southernmost glacier in the United States (the Palisades Glacier) is contained with the wilderness area.

Western elevations extend from the Sierra Nevada crest down to 1,219 meters where the South Fork of the San Joaquin River exits the Wilderness. East of the crest, the Wilderness includes eastern slopes of the Sierra Nevada roughly between Mammoth Lakes in the north and Owens Lake in the south, a distance of nearly 100 miles, and elevations between the highest elevation at Mt. Whitney (4,418 meters) and lowest elevations near 1,524 meters on the west side of the Owen Valley. Eastern portions are generally in the rain shadow of the Sierra Nevada. The San Joaquin Valley is the nearest major source region for emissions that could affect visibility in Wilderness areas west of the Sierra Nevada crest.

Figure 2. John Muir Wilderness Area



I.c. Kaiser Wilderness Area

The Kaiser Wilderness Area consists of 22,700 acres within the western slopes of the Sierra Nevada's Pacific Crest. It includes Kaiser Ridge, with elevations ranging from about 2,195 meters to 3,146 meters on Kaiser Peak in the center of the Wilderness. On the north side streams flow north into the San Joaquin River, and on the south side into Big Creek which merges with the San Joaquin River west of the Wilderness. The San Joaquin River flows westward and eventually opens up into the San Joaquin Valley 20 miles west of the Wilderness and just north of Fresno. The central San Joaquin Valley is the nearest major source region for emissions that could affect visibility within the Wilderness.

Figure 3. KAIS1 Monitor location

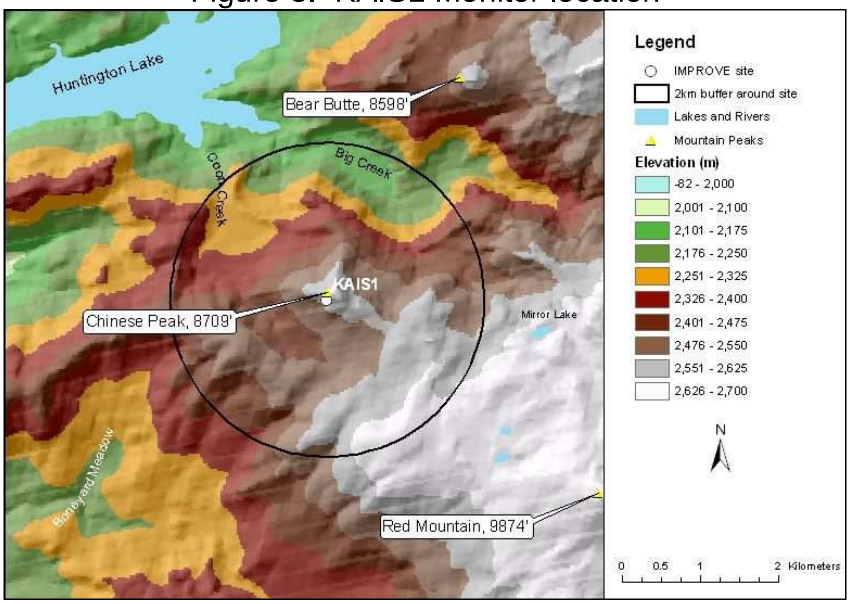


Figure 4. Looking west from the Kaiser monitoring site

Figure 5. KAIS1 Monitor location in California

Section II. Visibility Conditions:

II.a. Ansel Adams Wilderness Area

Visibility conditions for Ansel Adams Wilderness area are currently monitored by the KAIS1 IMPROVE monitor located in the Kaiser Wilderness Area. The monitor is located at 37.22 north latitude and 119.1546 west longitude, 79 meters below the crest of Chinese Peak across Huntington Lake and the Big Creek drainage to the south. The KAIS1 monitor is at an elevation of 2,598 meters, about 10 miles south of the southernmost boundary of Ansel Adams Wilderness Area. Data from KAIS1 should be representative of aerosol concentration and composition in Ansel Adams Wilderness Area.

The Ansel Adams Wilderness Area and vicinity are drained by the San Joaquin River, which flows into the San Joaquin Valley, the nearest source region. The San Joaquin River channel opens up into the San Joaquin Valley 20 to 25 miles to the southwest, where the primary population center is Fresno.

The KAIS1 location is adequate for assessing the 2018 reasonable progress goals for the Ansel Adams, John Muir, and Kaiser Wilderness Class I areas.

II.b. John Muir Wilderness Area

Visibility conditions for the John Muir Wilderness Area are currently monitored by the KAIS1 IMPROVE monitor in the Kaiser Wilderness Area. The monitor is located at 37.2207 north latitude and 119.1546 west longitude, 79 meters below the crest of Chinese Peak at an elevation of 2,598 meters, about 3 miles west of the western boundary of the John Muir Wilderness Area. The KAIS1 site is in a well exposed location with an unobstructed vista into the South Fork of the San Joaquin River headwaters. Data from KAIS1 should thus be representative of aerosol concentrations and composition in western portions of the John Muir Wilderness except at valley and canyon bottom locations during valley inversion conditions. KAIS1 is much less representative of John Muir Wilderness locations east of the Sierra Nevada crest, which are probably more susceptible to local emissions in the Owen Valley area, notably from Owens Dry Lake near the southern Wilderness boundary and a major source of windblown alkali dust.

The western John Muir Wilderness Area and vicinity are drained by the San Joaquin River, which flows into the San Joaquin Valley, the nearest source region. The San Joaquin River channel opens up into the San Joaquin Valley 20 to 25 miles to the southwest, where the primary population center is Fresno. The eastern John Muir Wilderness, on the eastern slopes of the Sierra Nevada, comprised much of the west side of the Owens Valley, the nearest local source region for emissions that could affect visibility west of the Sierra Nevada crest. Owens Valley includes Owens Lake, a major source of windblown dust.

The KAIS1 location is adequate for assessing the 2018 reasonable progress goals for the John Muir Wilderness Class 1 area.

II.c. Kaiser Wilderness Area

Visibility conditions for Kaiser are currently monitored by the KAIS1 IMPROVE monitor. The monitor is located at 37.2207 north latitude and 119.1546 west longitude, 79 meters below the crest of Chinese Peak across Huntington Lake and the Big Creek drainage to the south. KAIS1 is well exposed, with an unobstructed vista into Kaiser Wilderness from a distance of 3 to 6 miles. The elevation at KAIS1 is 2598 meters.

Data from KAIS1 should be very representative of aerosol concentrations and composition in the Kaiser Wilderness Area. The Kaiser Wilderness Area and vicinity are drained by the San Joaquin River, which flows into the San Joaquin Valley, the nearest source region. The San Joaquin River channel opens up into the San Joaquin Valley 15 to 20 miles to the Southwest, where the primary population center is Fresno. Potential local transport routes into the Kaiser Wilderness area include San Joaquin Valley emissions transported directly via diurnal upslope/down slope flow, or trapped under a persistent inversion. The most likely season for transport of San Joaquin emissions into the Kaiser Wilderness is summer. Springtime transport may be associated with agricultural and forest prescribed burning in San Joaquin Valley and National Forest lands. Autumn transport is less frequent because of a persistent San Joaquin Valley inversion that confines emissions to lower elevations.

The KAIS1 location is adequate for assessing the 2018 reasonable progress goals for the Kaiser Wilderness Class 1 area.

II.d. Baseline Visibility

Baseline visibility is determined from KAIS1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the KAIS1 wilderness areas is calculated at 2.3 deciviews for the 20% best days and 15.5 deciviews for the 20% worst days. Figure 6 represents the worst baseline visibility conditions.

II.e. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the KAIS1 wilderness areas is 0.04 deciviews for the 20% best days and 7.1 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.f. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 6 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 13.57 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 2.3 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 6. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)

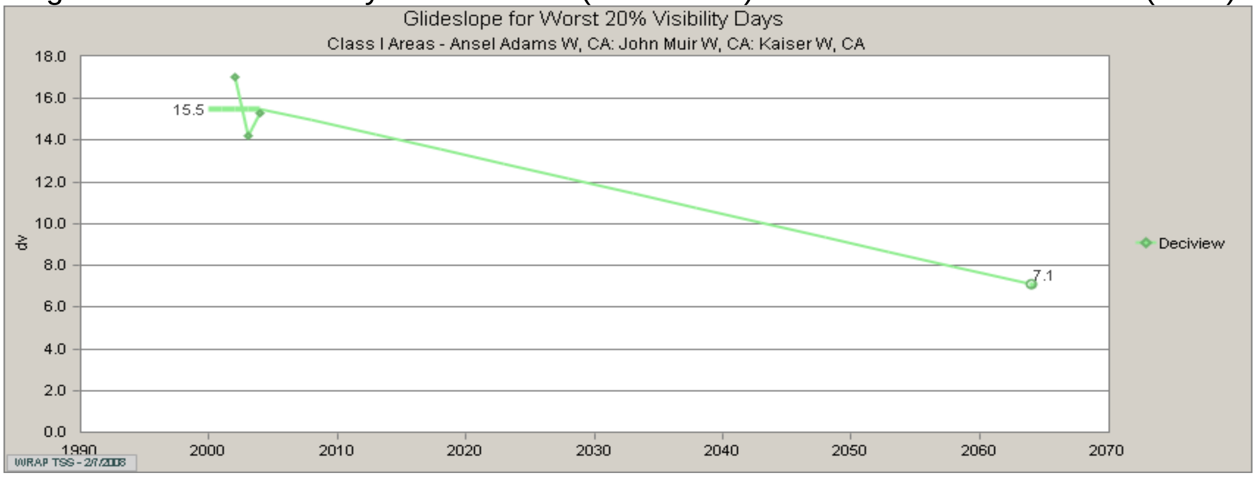
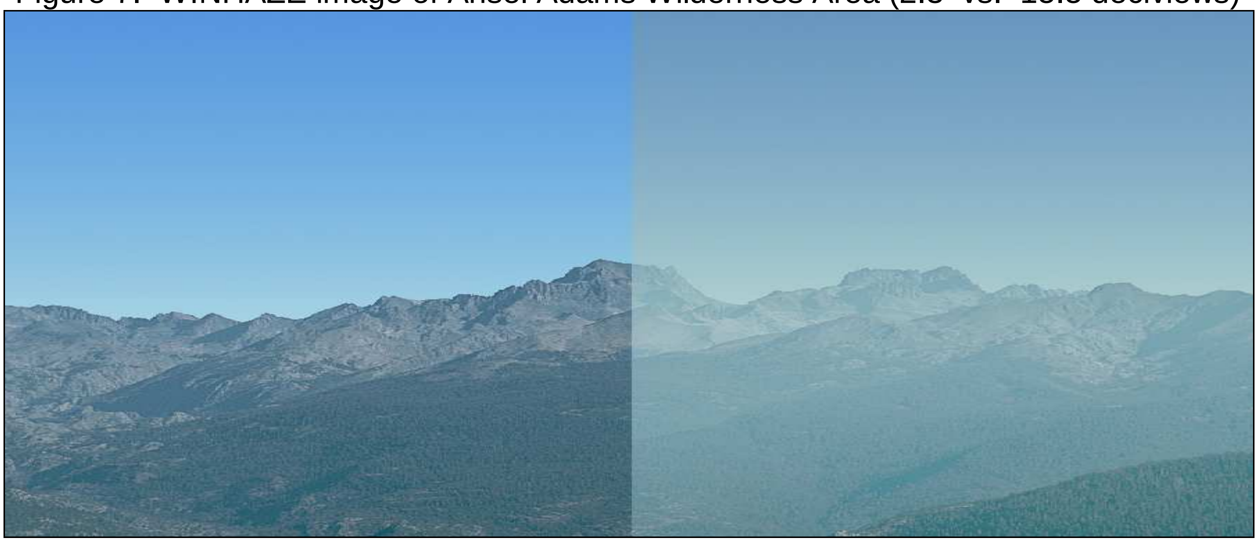


Figure 7. WINHAZE image of Ansel Adams Wilderness Area (2.3 vs. 15.5 deciviews)



II.g. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 8 shows the contribution of each species to the 20% best and worst days in the baseline years at KAIS1.

Figure 8. Average haze species contributions to light extinction in the baseline years

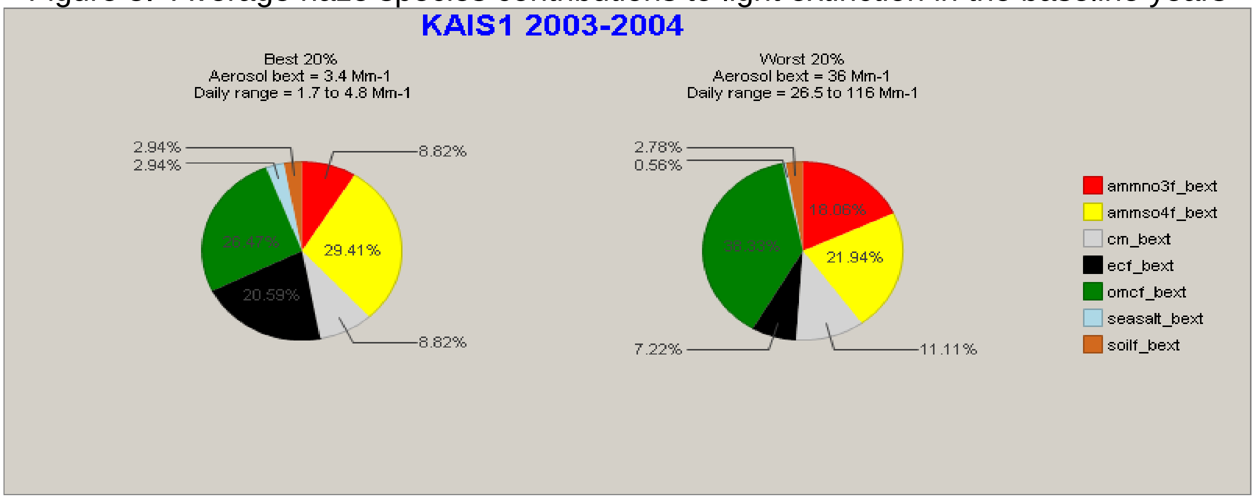
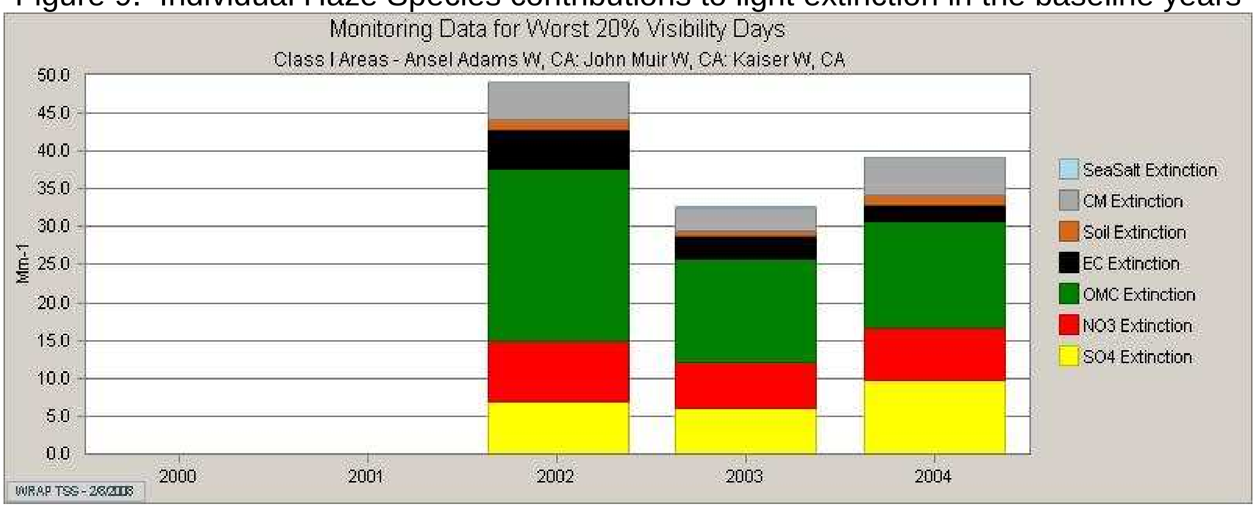


Figure 9. Individual Haze Species contributions to light extinction in the baseline years



As shown in Figures 8 and 9, organic matter, sulfates, and nitrates have the strongest contributions to degrading visibility on the worst days at the KAIS1 monitor. The worst days are dominated by organic matter, while the best days are dominated by sulfate. Data points for 2000 and 2001 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 10 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and early spring while sulfates increase slightly in the summer months. Organic matter remains high throughout the summer. Organic matter clearly dominates the other haze species on worst days, but nitrates, sulfates, coarse mass and elemental carbon also contribute to the worst days in the summer. There are only trace amounts of sea salt seen throughout the year.

Figure 11 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 10 for organic matter, nitrates, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires. The spike in late July of 2002 can be attributed to smoke transported into the Central Valley of California from the Biscuit Fire which burned almost 500,000 acres in the Siskiyou National Forest in southwestern Oregon and the Six Rivers National Forest in northwestern California. The spike in organic carbon for the months of August and September of 2002 can be attributed to the McNally fire which burned 150,670 acres in the Sequoia National Forest.

Figure 10. Species contribution on the 20% worst days in 2002

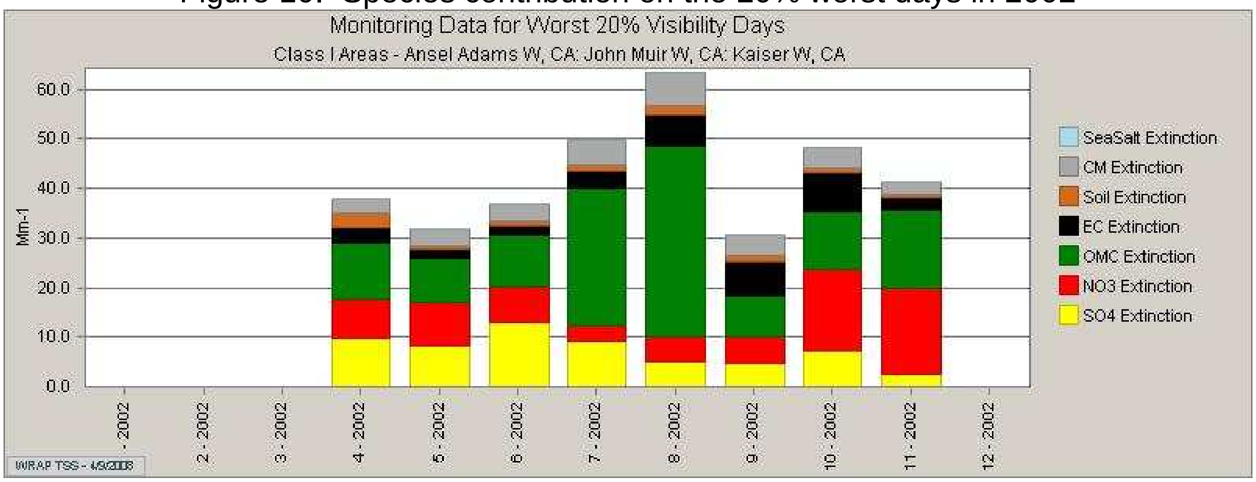
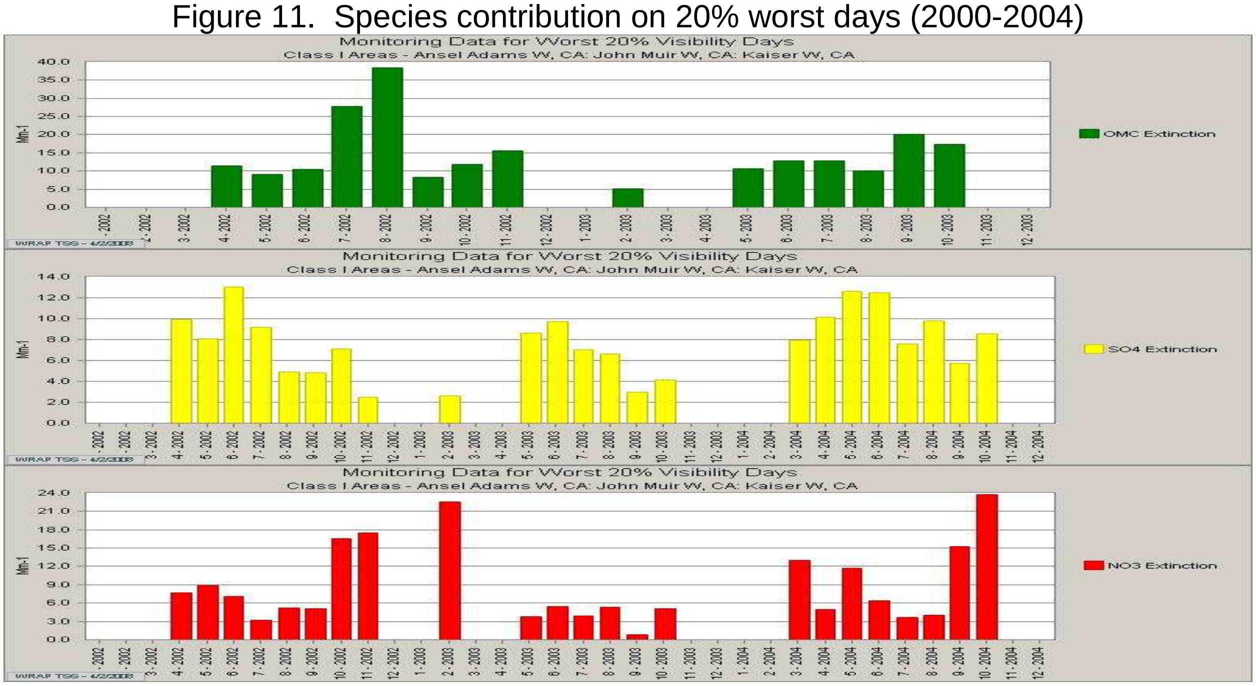


Figure 11. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at KAIS1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 12 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the KAIS1 monitor is from natural fire sources within California. California represents 86% of all natural fire source contributions.

Figure 13 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 73% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 24% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 14 and 15 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at KAIS1. The Outside Domain region represents 45% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (35%) and the Pacific Offshore Region (15%). California contributes 19% of the total sulfate emissions seen at the KAIS1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the KAIS1 monitor. The next largest contributor to sulfate concentrations is from area sources in the Pacific Offshore Region.

Figures 16 and 17 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (74%), followed by the Outside Domain Region (20%) and emissions from Pacific Offshore (6%). Mobile sources within California contribute the most nitrate at the KAIS1 monitor. In 2002, 63% of the nitrate at the KAIS1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most to nitrate concentrations at the KAIS1 monitor in 2002 and 2018. Currently, California mobile sources are 73% of California contributions to nitrate at the KAIS1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 12. Organic carbon source contribution from CA and outside regions

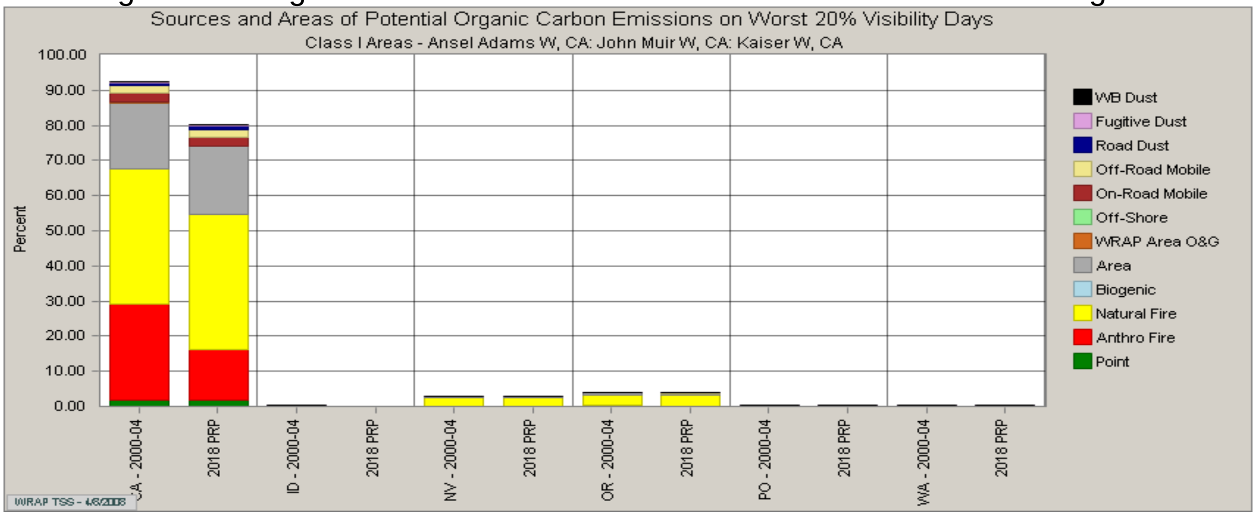


Figure 13. Organic carbon Anthropogenic and Biogenic Source Apportionment

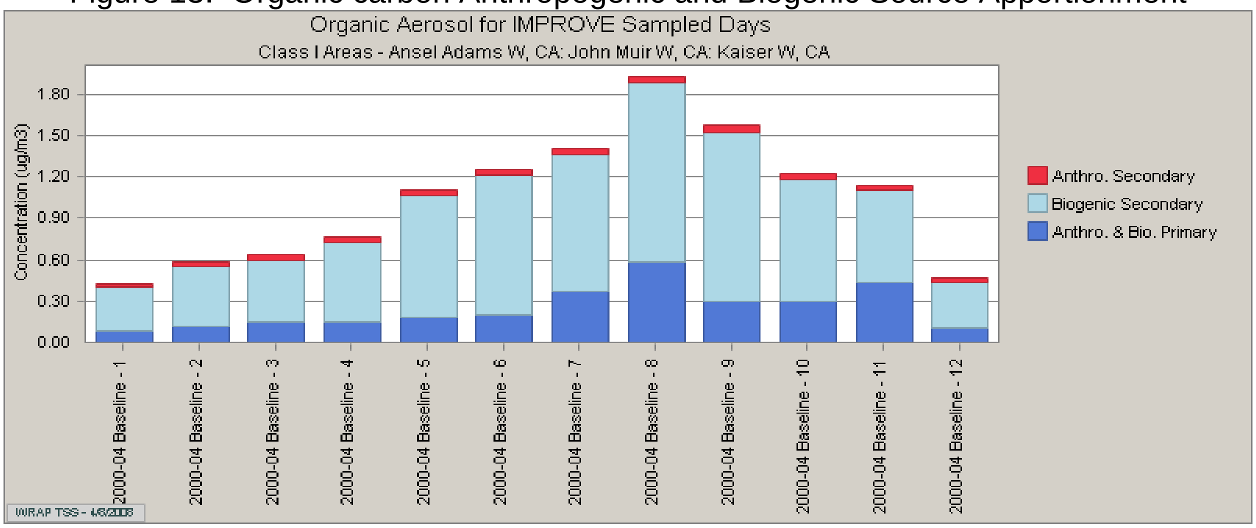


Figure 14. Regional Sulfate Contribution to Haze in 2002 and 2018

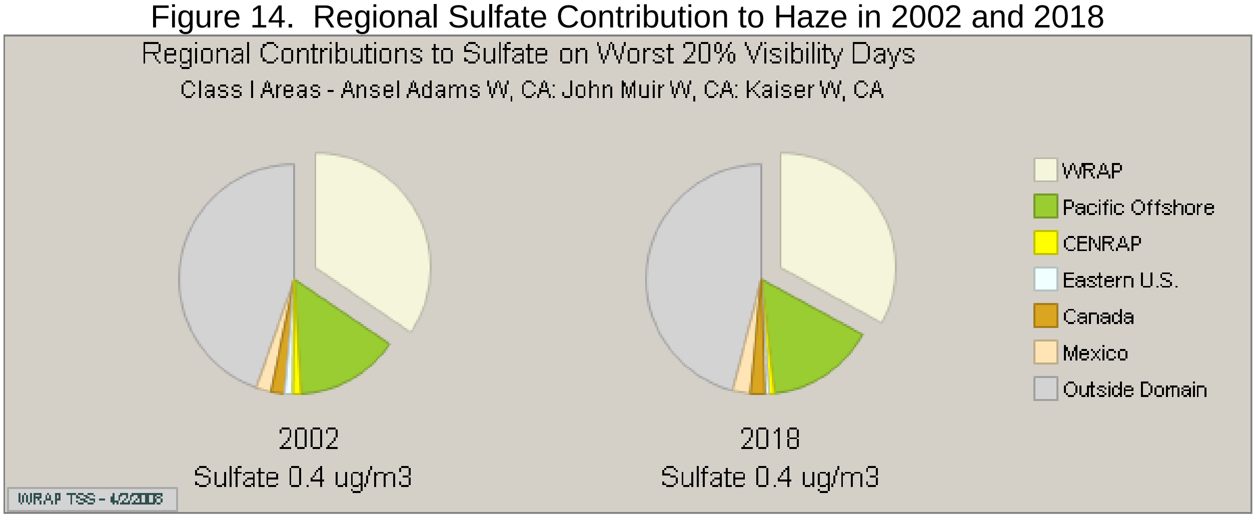


Figure 15. Sulfate source contribution from CA and outside regions

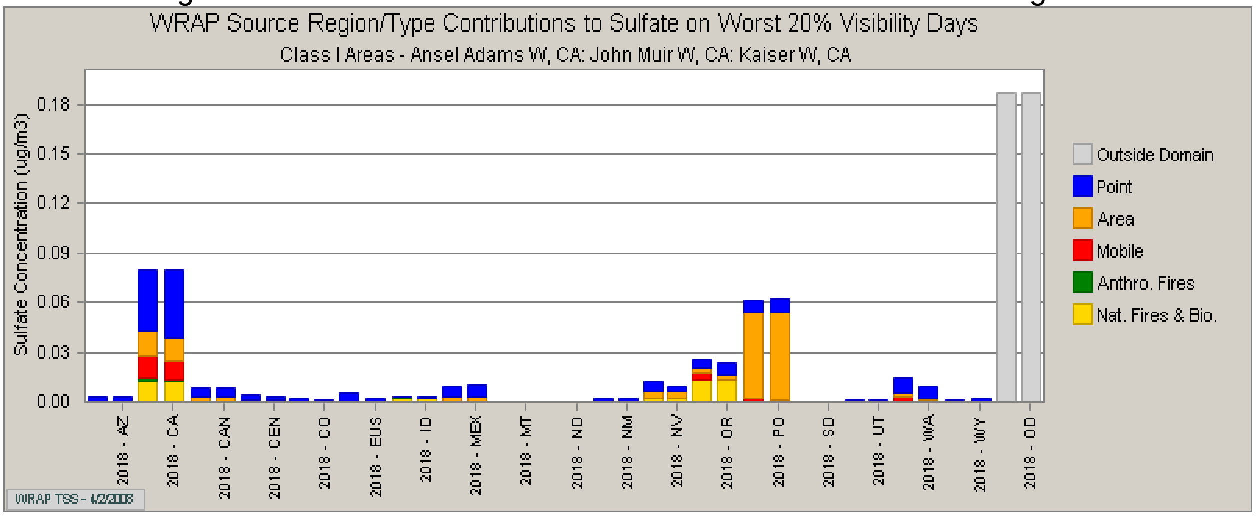


Figure 16. Regional Nitrate Contribution to Haze in 2002 and 2018

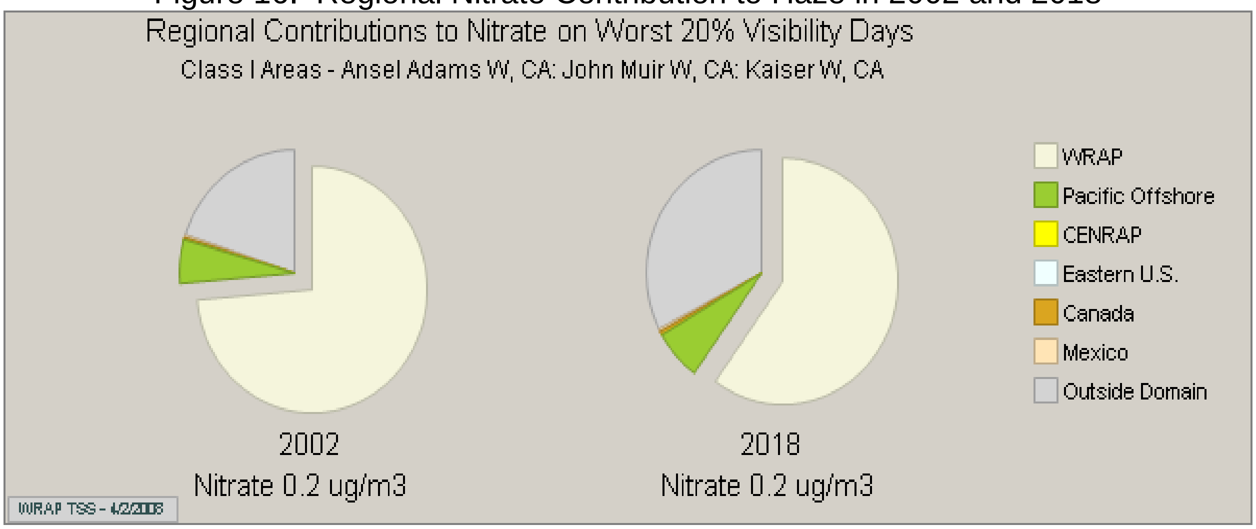
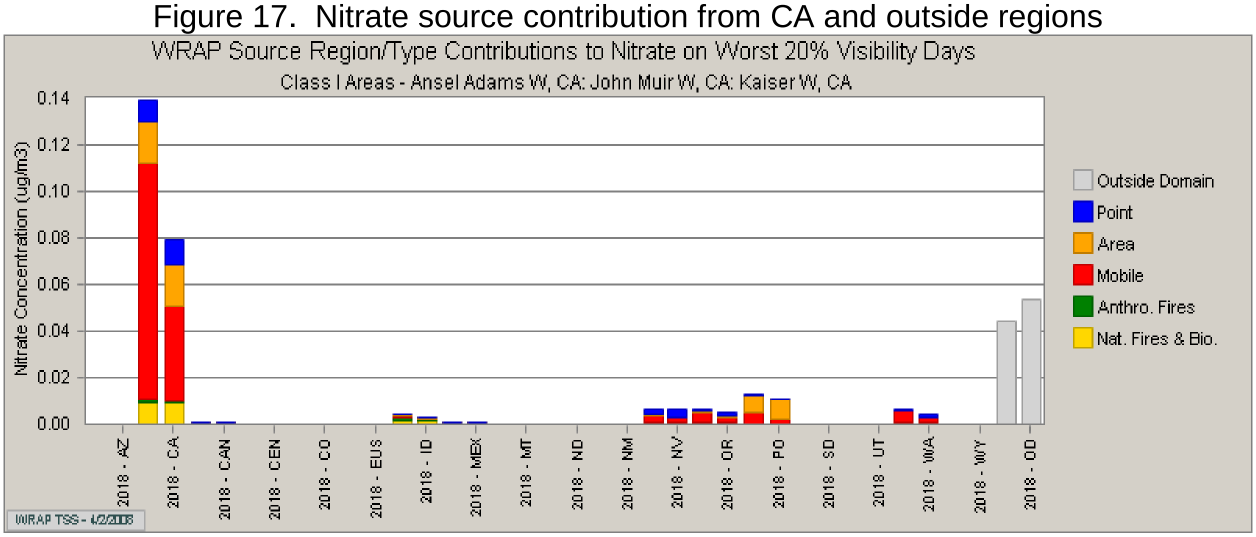


Figure 17. Nitrate source contribution from CA and outside regions



SEQU1 Monitor

The SEQU1 monitor location represents two wilderness areas located in the Southern Sierra Nevada Mountain Range. The wilderness areas associated with the SEQU1 monitor are Kings Canyon and Sequoia National Parks. Although data on haze pollutants has only been collected since 1997, the site has been operating since March 1992. This site has sufficient data for the five baseline years of 2000 – 2004.

Section I. SEQU1 National Park Descriptions

I.a. Kings Canyon National Park

Kings Canyon National Park consists of 459,994 acres of the western slopes of the southern Sierra Nevada range. Sequoia and Kings Canyon National Parks share a long boundary and are managed as one park, with Kings Canyon NP to the north of Sequoia NP. Kings Canyon National Park elevations range from around 1,219 meters where westward flowing streams exit the Park on the west side, to over 3,962 meters along the Sierra Nevada crest that forms the eastern boundary and culminates at the peak of Mt. Whitney at the Sequoia NP boundary. Essential topographic features of Kings Canyon include the Middle and South Forks of the Kings River that flow from the Sierra Nevada crest and merge 6 miles west of the National Park boundary, ultimately flowing into Pine Flat Reservoir and opening up into the San Joaquin Valley 25 miles east of Fresno. The Middle Fork of Kings River flows through the steep and narrow Kings Canyon, near 762 meters deep and 1 to 2 miles wide at the rim. Lowest elevations at the western boundary where the tow Forks of the Kings River exit the National Park are near 1,219 meters. San Joaquin Valley is the source of most local emissions that affect visibility within the Park.

Figure 1. Kings Canyon National Park

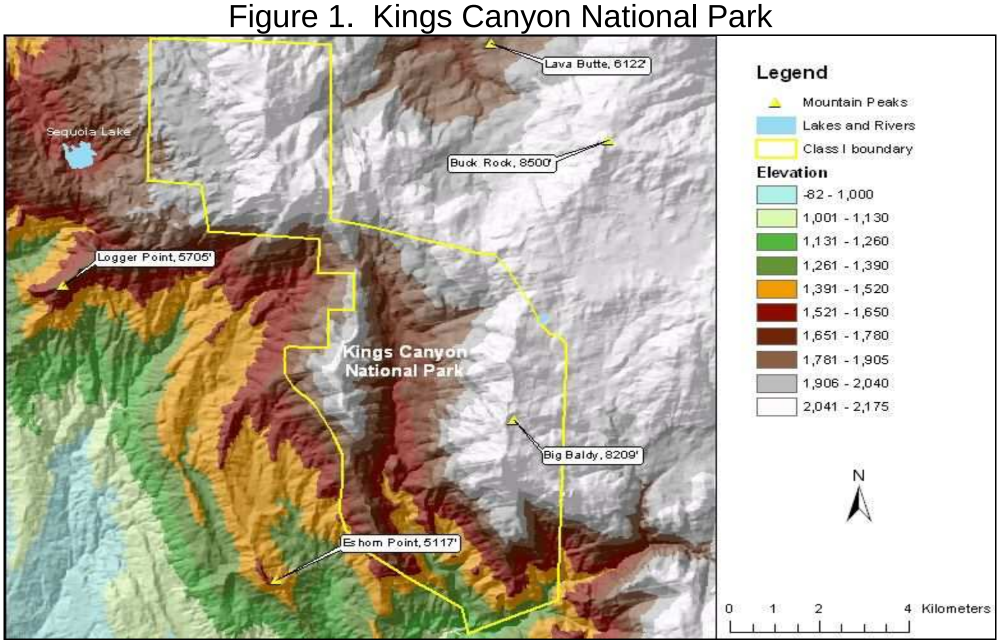


Figure 2. Photograph of Kings Canyon National Park

I.b. Sequoia National Park

Sequoia National Park (Sequoia) consists of 386,642 acres of the western slopes of the southern Sierra Nevada range. Sequoia and Kings Canyon National Parks share a long boundary and are managed as one park, with Kings Canyon National Park (Kings Canyon) to the north of Sequoia. Elevations range from around 457 meters where westward flowing streams exit the Park on the west side, to over 3,962 meters along the Sierra Nevada crest that forms the eastern boundary and culminates at the peak of Mt. Whitney, at an elevation of 4,417 meters. Essential topographic features include the North, Middle and East Forks of the Kaweah River that flow out of the Park on the west side and the Kern River that flows southward out of the eastern Park area. These drainages connect the Park with central and southern portions of the San Joaquin Valley, the source for most local emissions that affect visibility within the Park.

Figure 3. SEQU1 Monitor location

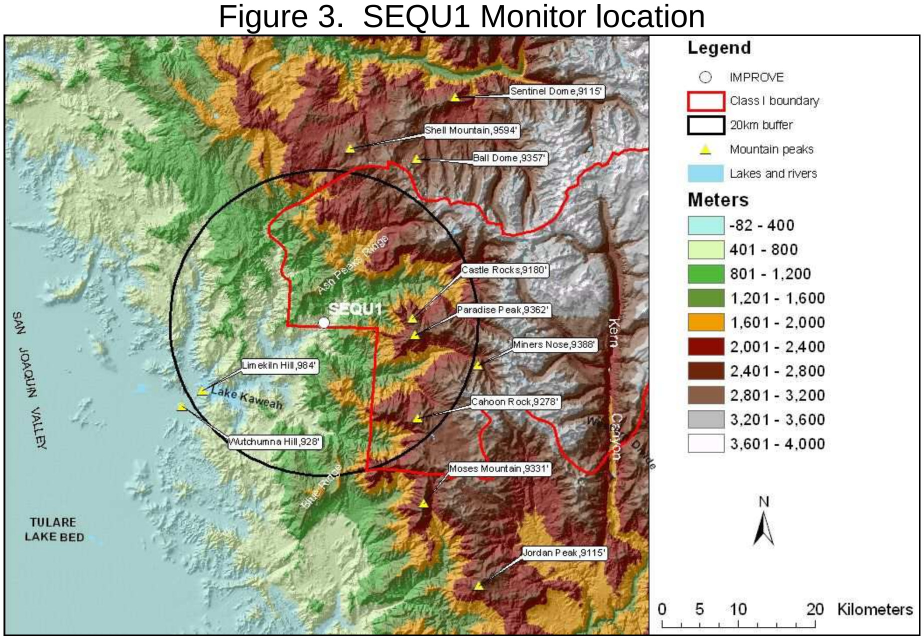


Figure 4. Photograph of Sequoia National Park

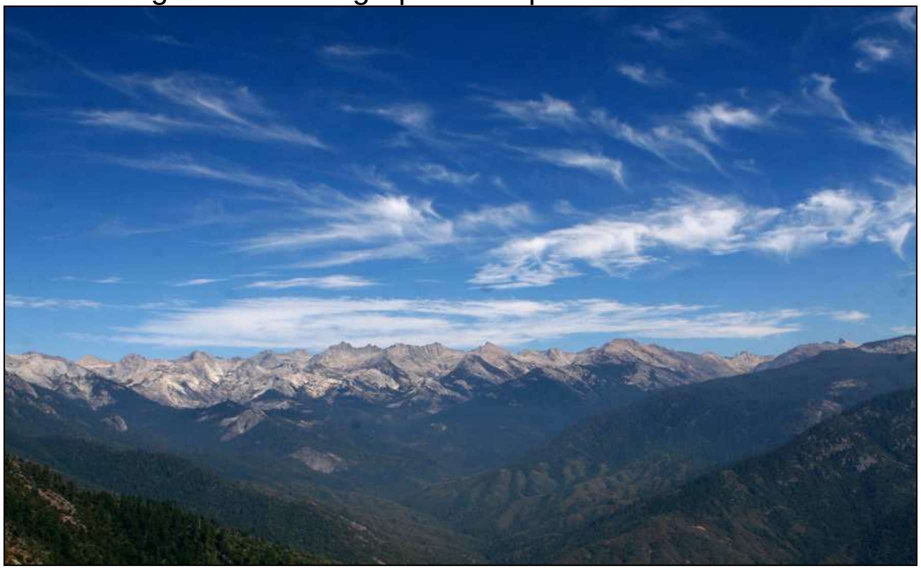


Figure 5. SEQU1 Monitor location in California

Section II. Visibility Conditions:

II.a. Kings Canyon National Park

Visibility conditions for Kings Canyon are currently monitored by the SEQU1 IMPROVE monitor. The monitor is located at 36.49 north latitude and 118.83 west longitude in the Middle Fork of the Kaweah River drainage near its exit from the Sequoia National Park south of Kings Canyon. At an elevation of 519 meters, the site is about 64 meters above the river.

SEQU1 is situated near the bottom of one of the valleys that drain Sequoia National Park on its west side, at the very lowest end of elevation ranges within Sequoia NP and well below the lowest Kings Canyon elevations. It is well located for observing San Joaquin Valley emissions at western park boundaries, and emissions from more local sources, and may represent highest aerosol concentrations and most severe visibility impacts within Park boundaries. During inversion conditions it may not be as representative of aerosol concentrations and composition at highest Sequoia and Kings Canyon elevations that could be impacted by emission from more distant source regions on a synoptic to global scale. It may be less representative of aerosol characteristics in the more distant Kings Canyon National Park than in Sequoia National Park. Kings River Middle and South Forks exit Kings Canyon about 25 miles east of central San Joaquin Valley and 50 miles east of Fresno. Lowest elevations of Kings Canyon are around 701 meters higher than lowest elevations of Sequoia and the SEQU1 monitoring site, and are near the upper end of the typical summertime San Joaquin Valley mixing heights. SEQU1 aerosol data should still represent maximum impact within the two Parks due to San Joaquin Valley emissions.

The SEQU I location is adequate for assessing the 2018 reasonable progress goals for the Kings Canyon National Park Class 1 area.

II.b. Sequoia National Park

Visibility conditions for Sequoia are currently monitored by the SEQU1 IMPROVE monitor operated by the National Park Service. The monitor is located at 36.49 north latitude and 118.83 west longitude in the Middle Fork of the Kaweah River drainage near its exit from the Park. At an elevation of 519 meters, the site is about 64 meters above the river.

The monitoring location is at the western boundary of the Sequoia National Forest, in the foothills of the Sierra Nevada, and in the lowest elevation range of the Forest. It is well-located for observing localized air flows along the Kaweah River drainage and from the adjacent San Joaquin Valley. The elevation of the SEQU1 IMPROVE monitoring station is within both the summer and winter inversion layers of the San Joaquin Valley. Since it receives transported emissions from the San Joaquin Valley, the monitor may register the highest aerosol concentrations and most severe visibility impacts within the Forest boundaries. During inversion conditions, the measurements may not be as representative of aerosol concentration and composition at higher Park elevations that could be impacted by emissions from more distant source regions on a synoptic to global scale.

The SEQU I location is adequate for assessing the 2018 reasonable progress goals for the Sequoia National Park Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from SEQU1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the SEQU1 monitor is calculated at 8.8 deciviews for the 20% best days and 25.4 deciviews for the 20% worst days. Figure 6 represents the worst baseline visibility conditions.

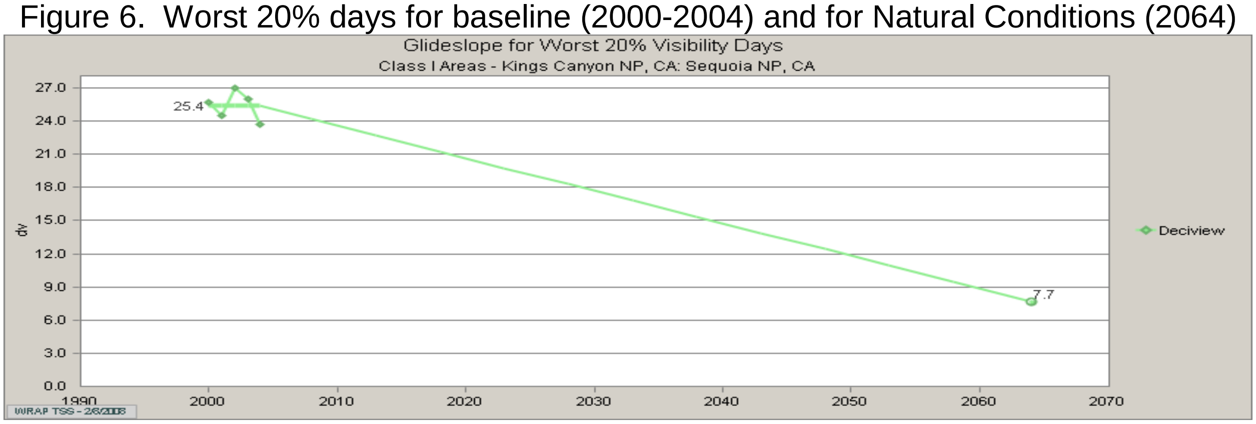
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the SEQU1 monitor is 2.3 deciviews for the 20% best days and 7.7 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 6 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 21.24 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 8.8 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 6. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 7 shows the contribution of each species to the 20% best and worst days in the baseline years at SEQU1.

Figure 7. Average Haze species contributions to light extinction in the baseline years

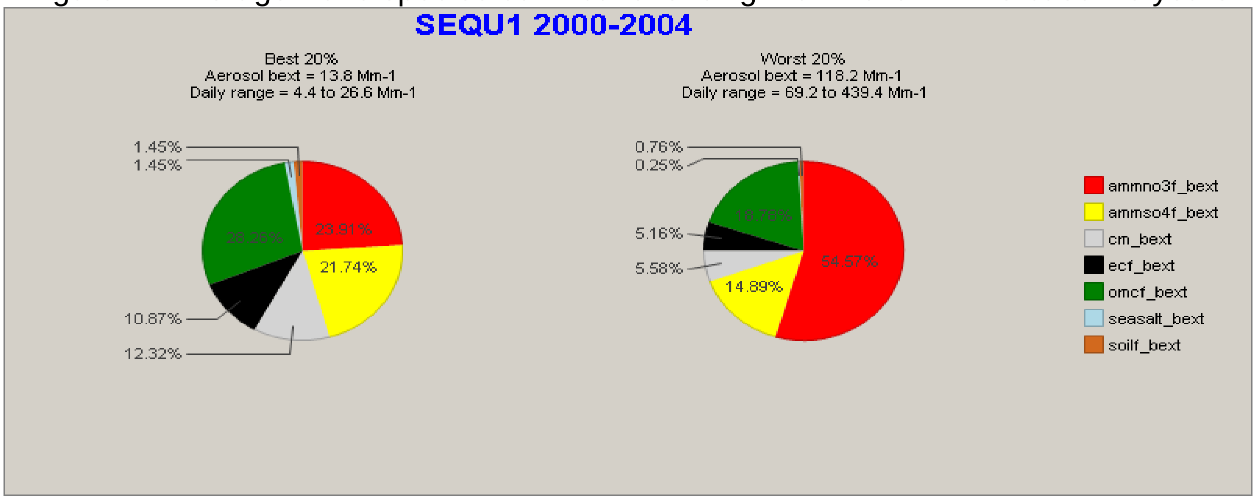
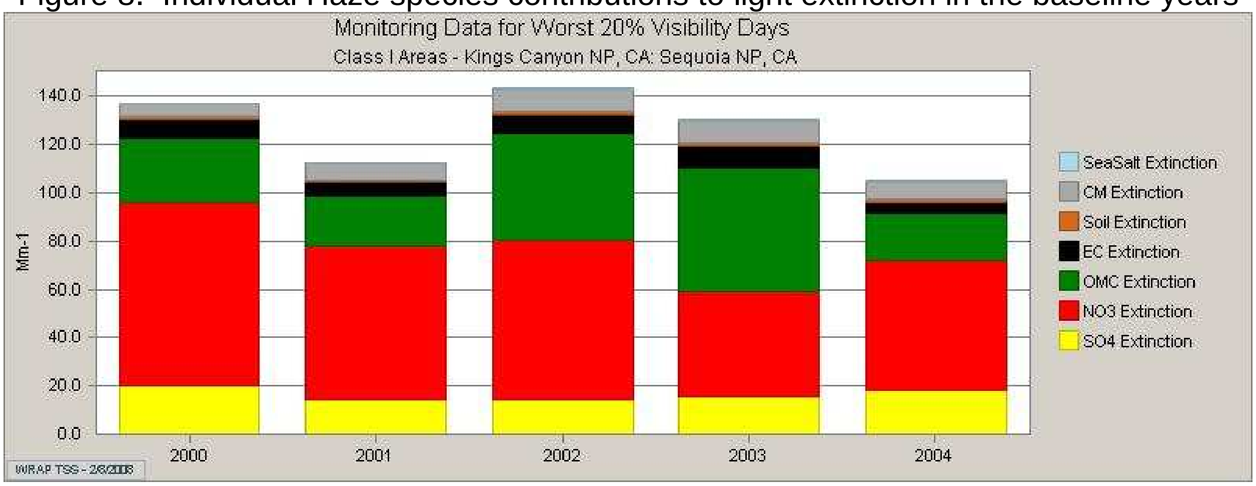


Figure 8. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 7 and 8, nitrates, organic matter, and sulfates have the strongest contributions to light extinction which degrade visibility on worst days at the SEQU1 monitor. The worst days are dominated by nitrates, while the best days are dominated by organic matter.

Figure 9 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and spring while sulfates increase slightly in the spring and summer months. Organic matter remains high throughout the summer. Nitrates clearly dominate the other haze species on worst days, but organic matter, sulfates, coarse mass and elemental carbon also contribute to the worst days in the summer. There are only trace amounts of sea salt and soil present throughout the year.

Figure 10 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 9 for nitrates, organic matter, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 9. Species contribution on the 20% worst days in 2002

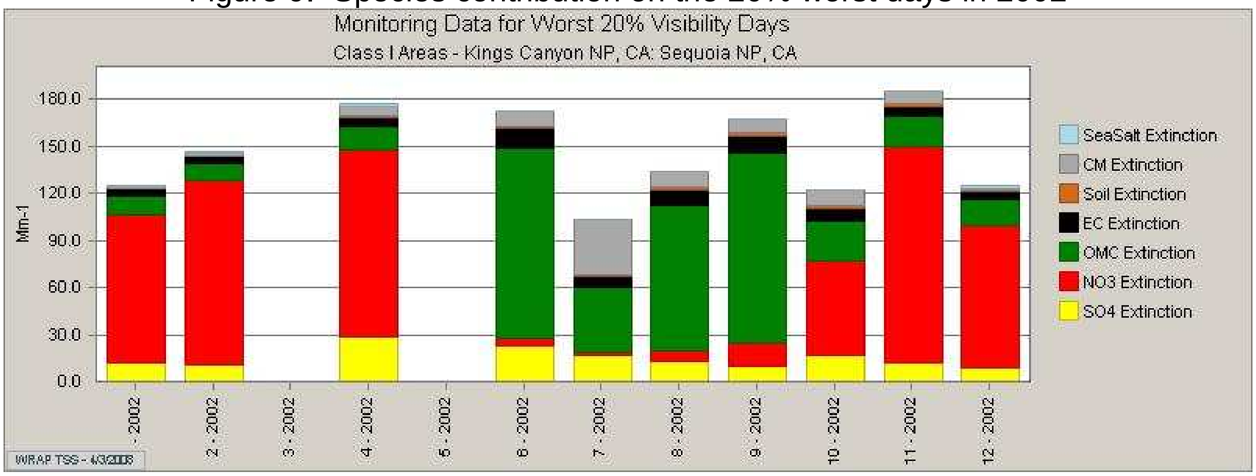
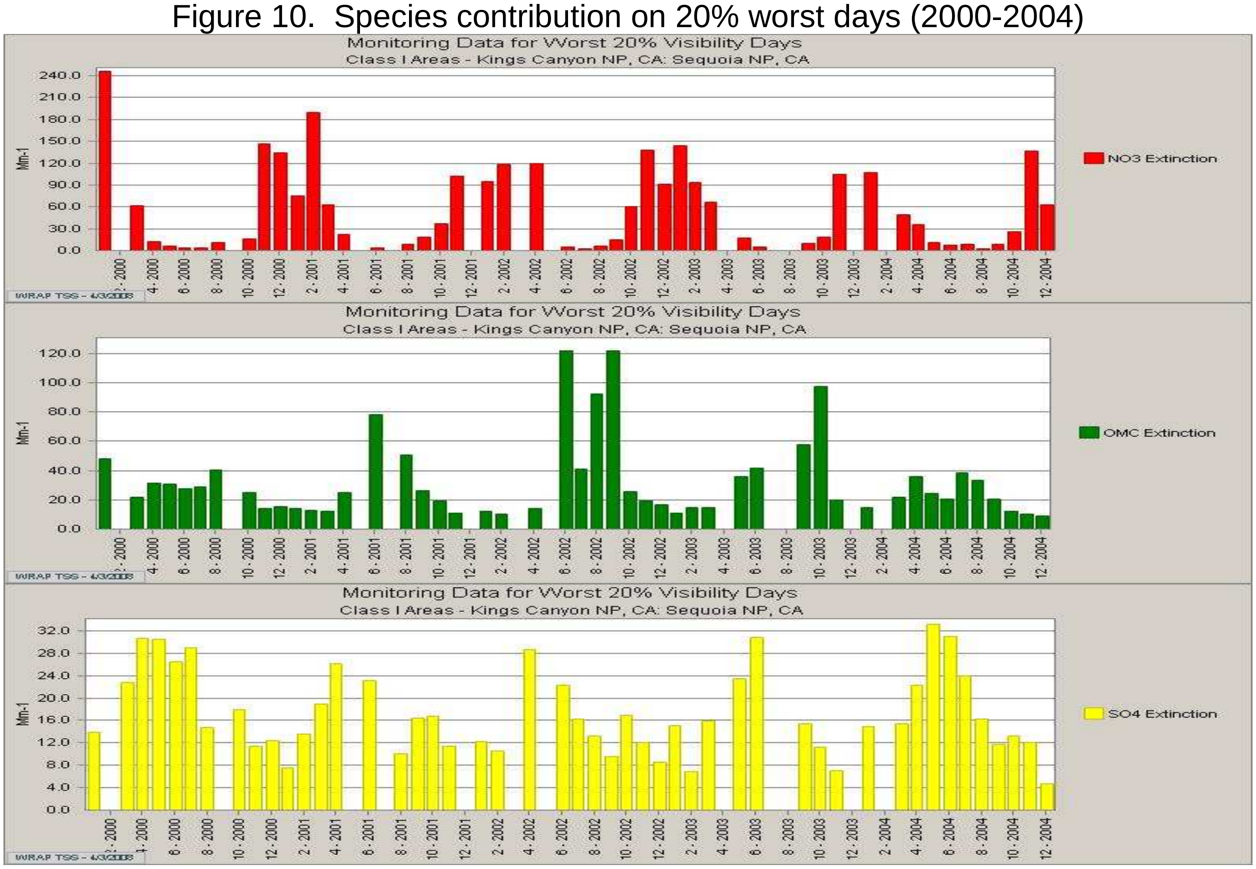


Figure 10. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at SEQU1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 11 and 12 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (86%), followed by the Outside Domain Region (9%) and emissions from Pacific Offshore (4%). Mobile sources within California contribute the most nitrates at the SEQU1 monitor. In 2002, 94% of the nitrate from mobile sources at the SEQU1 monitor can be attributed to California. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 13 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the SEQU1 monitor is from natural fire sources within California. California represents 97% of all natural fire source contributions.

Figure 14 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 60% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 35% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 15 and 16 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at SEQU1. The Outside Domain region represents 48% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (35%) and the Pacific Offshore Region (13%). California contributes 25% of the total sulfate emissions seen at the SEQU1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the SEQU1 monitor. Pacific Offshore area sources and California point sources contribute an equal amount to the sulfate concentrations at the SEQU1 monitor following outside the modeling domain.

Figure 11. Regional Nitrate Contribution to Haze in 2002 and 2018

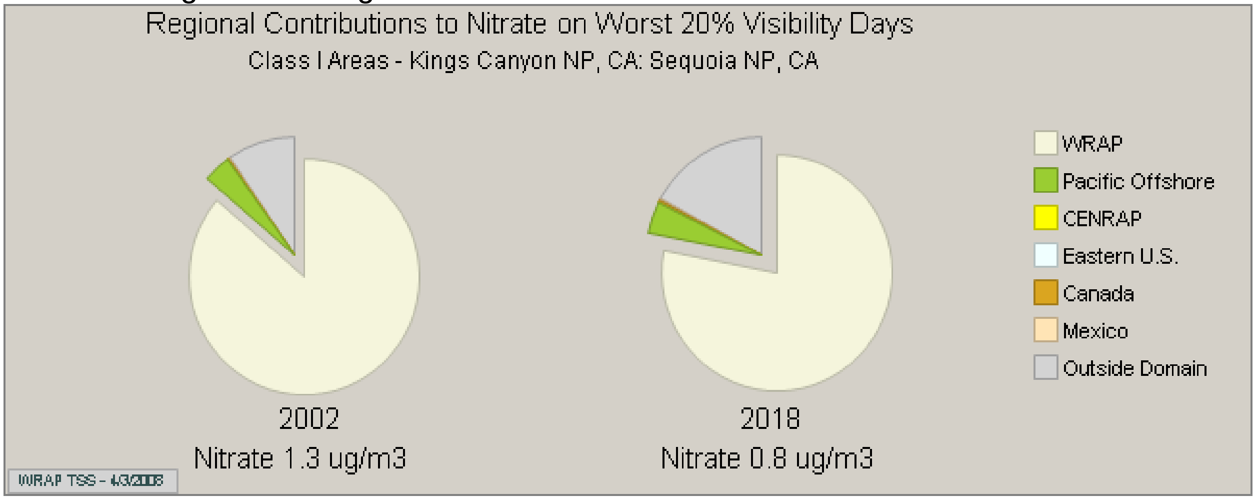


Figure 12. Nitrate source contribution from CA and outside regions

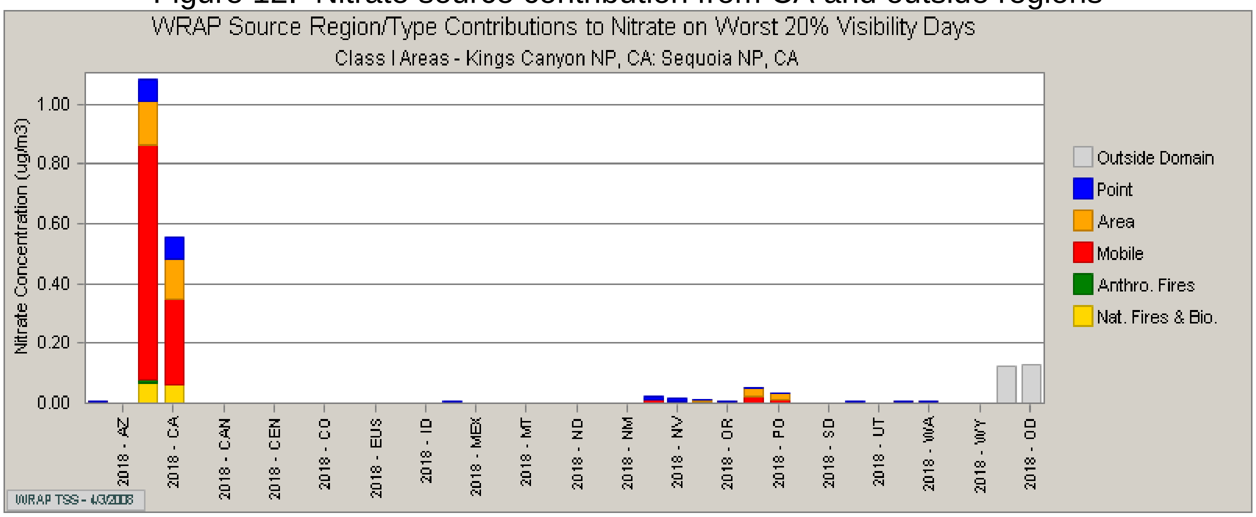


Figure 13. Organic carbon source contribution from CA and outside regions

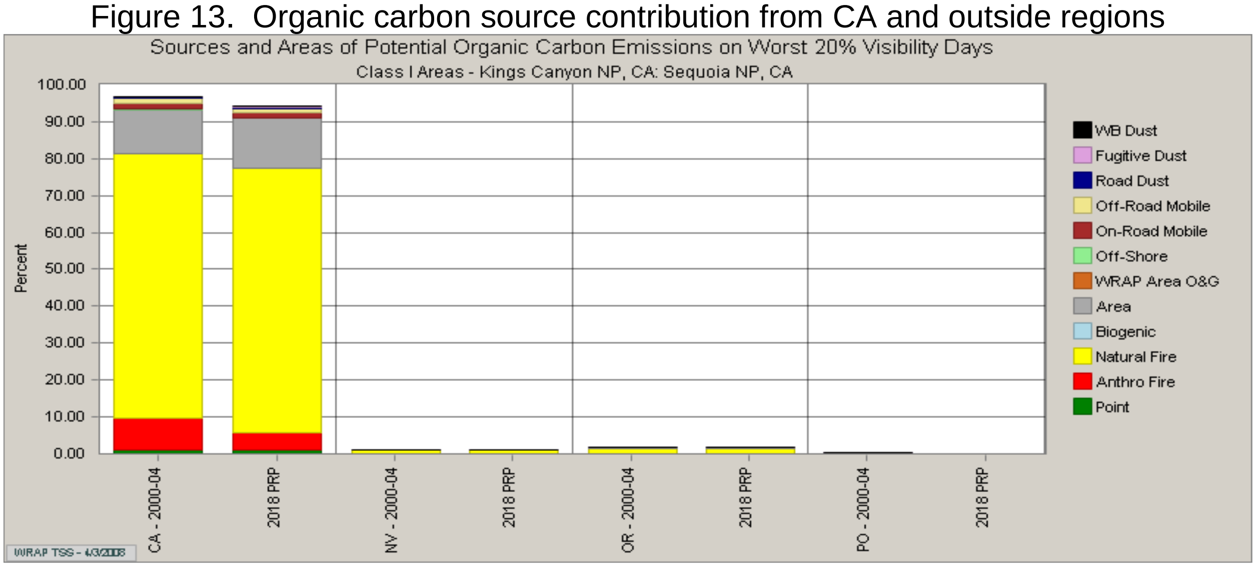


Figure 14. Organic carbon Anthropogenic and Biogenic Source Apportionment

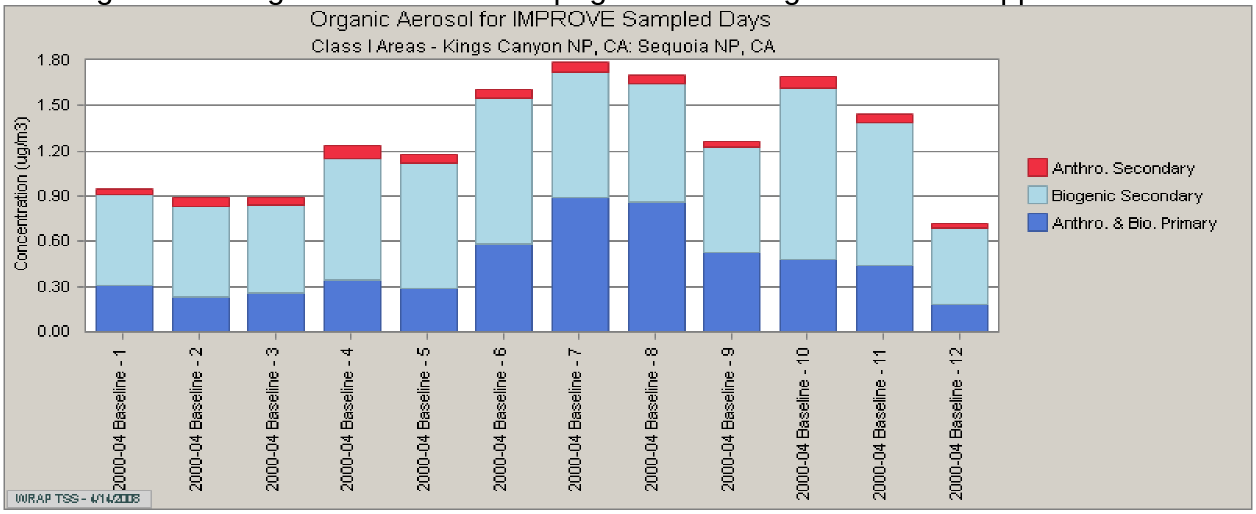


Figure 15. Regional Sulfate Contribution to Haze in 2002 and 2018

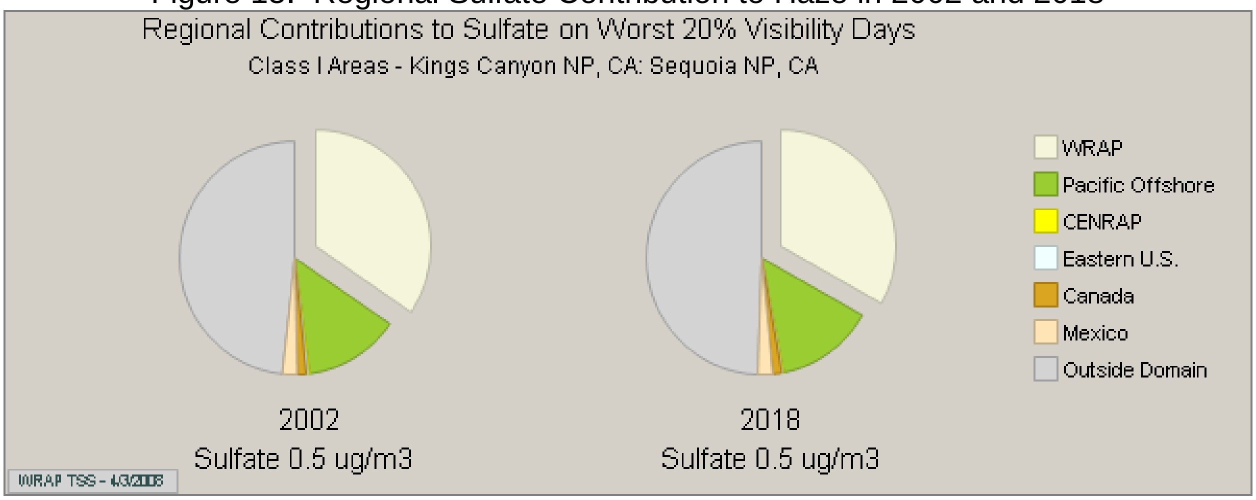
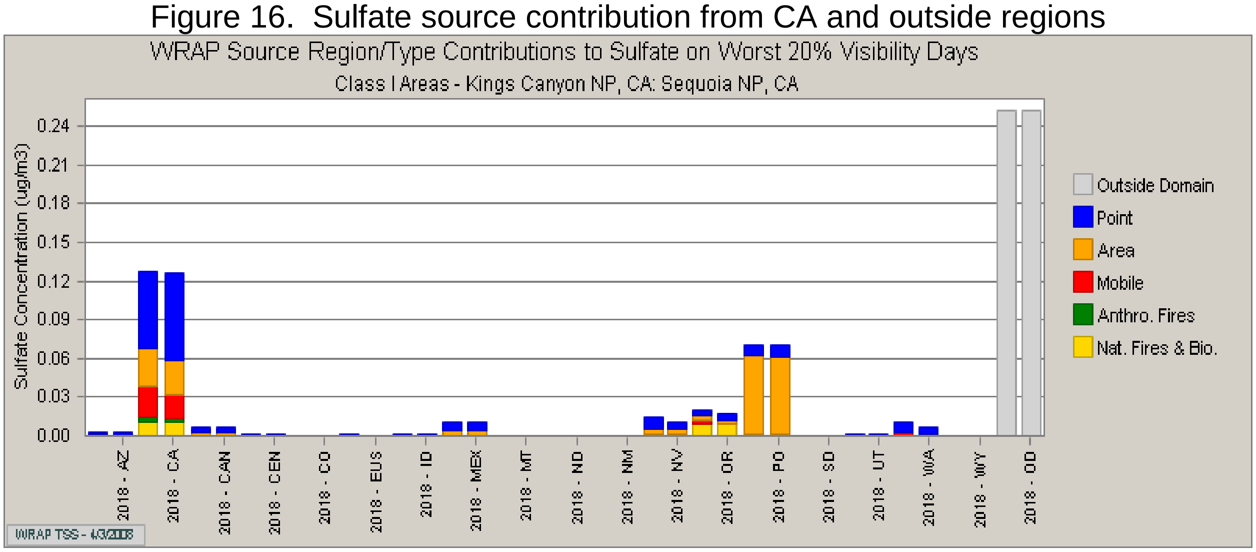


Figure 16. Sulfate source contribution from CA and outside regions



DOME1 Monitor

Section I. Description

Dome Land Wilderness Area (Dome Land) consists of about 131,000 acres of the southern end of the Kern Plateau, 70 miles northeast of Bakersfield. Elevations range from 914 to 2,966 meters. Dome Land Wilderness is bisected by the South Fork of the Kern River that flows southwest towards Bakersfield and the southern end of the San Joaquin Valley, where the elevation is near 152 meters and which is the nearest source region for anthropogenic emissions that may affect visibility in the Dome Land Wilderness Area.

Figure 1. DOME1 Monitor location

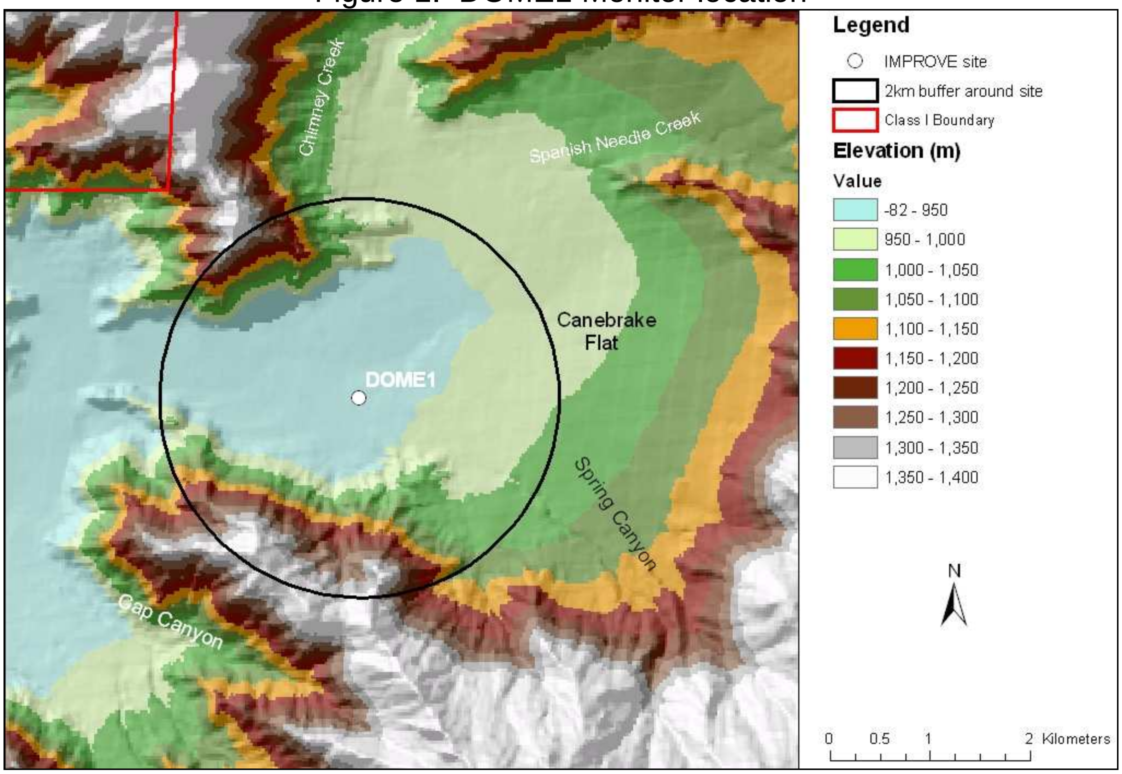
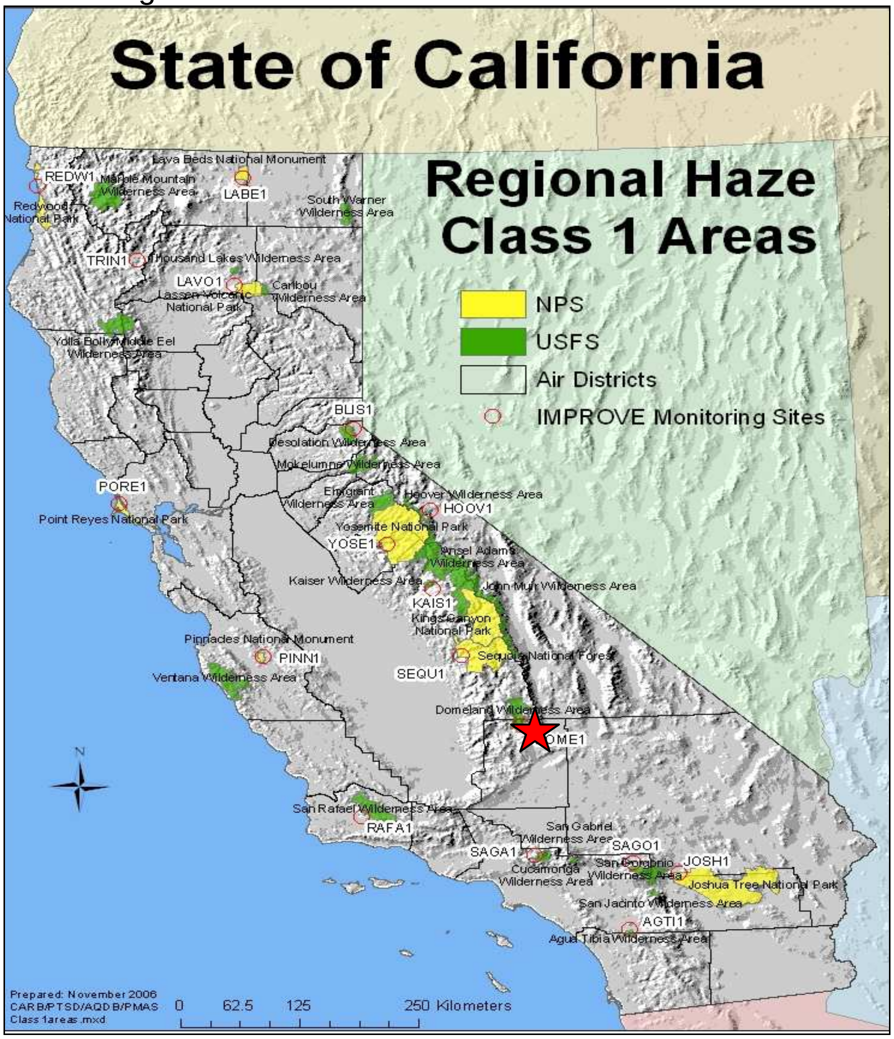


Figure 2. WINHAZE image of Dome Land Wilderness Area (5.1 vs. 19.4 deciviews)

Figure 3. DOME1 Monitor location in California



Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for Dome Land Wilderness are currently monitored by the DOME1 IMPROVE monitor. The monitor is located at 35.7278 north latitude and 118.1377 west longitude in the valley of the South Fork of the Kern River a few miles downstream from its exit from the wilderness. The DOME1 site elevation is 927 meters, the lowest end of the range of Dome Land Wilderness elevations. The site has been operating since February 2000. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2000.

Aerosol data from DOME1 should be representative of locations in Dome Land Wilderness Area. The nearest population center is Bakersfield and the southern San Joaquin Valley, 70 miles southwest. This source region is the nearest source for emissions that could contribute to haze in Dome Land Wilderness, via low-level transport up the South Fork of the Kern River, via upward mixing and upper level transport by prevailing westerly winds, or trapped beneath a regional subsidence inversion.

The DOME1 location is adequate for assessing the 2018 reasonable progress goals for the Dome Land Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from DOME1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the Dome Land Wilderness is calculated at 5.1 deciviews for the 20% best days and 19.4 deciviews for the 20% worst days. Figure 3 represents the worst baseline visibility conditions.

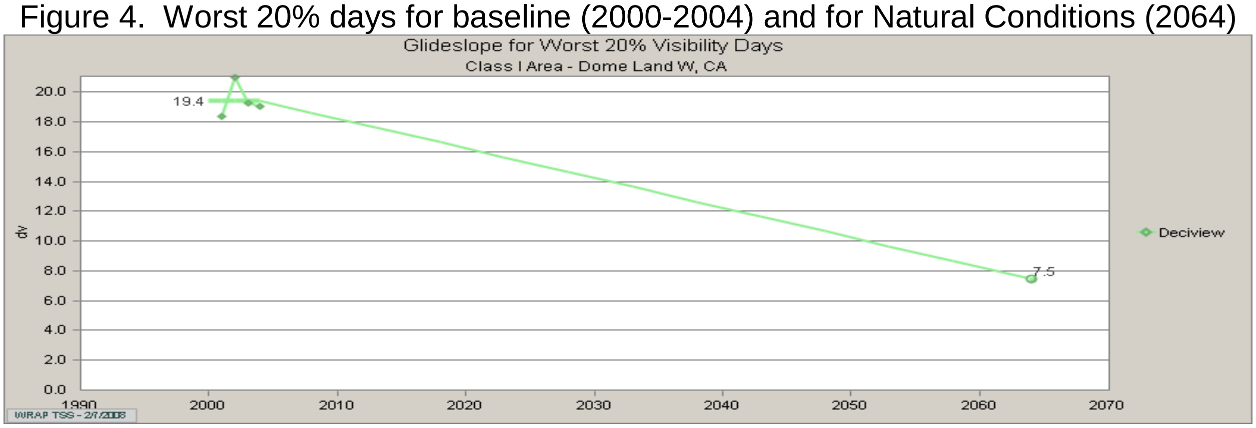
II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the Dome Land Wilderness is 1.2 deciviews for the 20% best days and 7.5 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 3 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 16.64 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 5.1 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at DOME1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

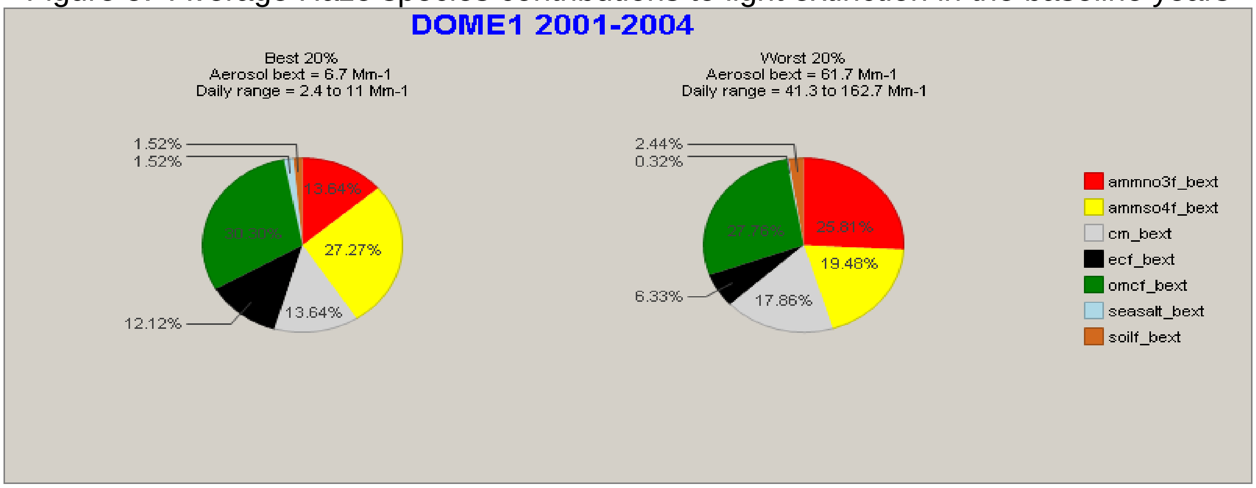
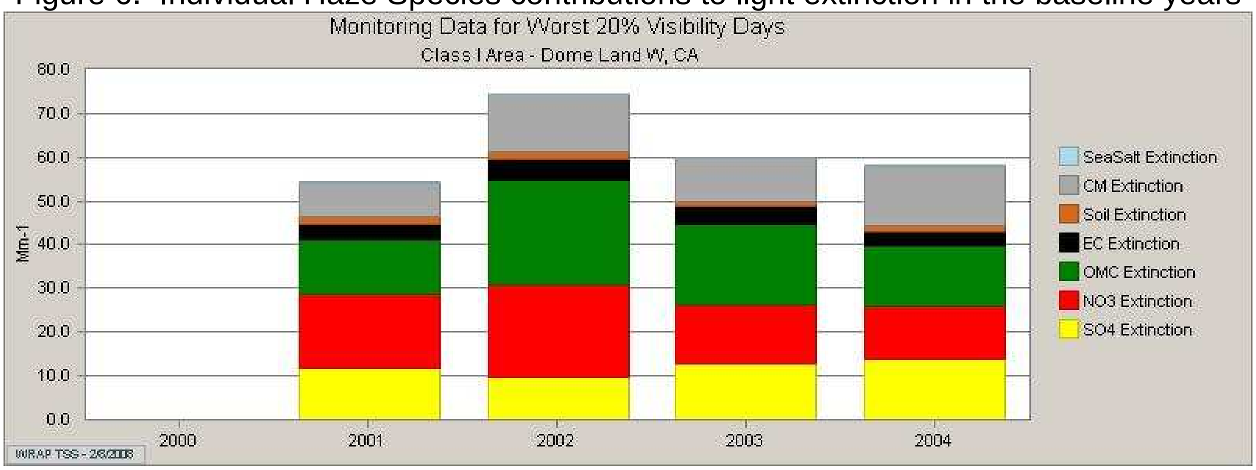


Figure 6. Individual Haze Species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, organic matter, nitrates, and sulfates have the strongest contributions to degrading visibility on worst days at Dome Land Wilderness Area. The worst and best days are dominated by organic matter. Data points for 2000 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 7 depicts the individual species contribution on worst days in 2003. The occurrence of elevated organic matter concentrations is sporadic throughout the year. Sulfates remain relatively stable throughout the year but see a slight increase in the early summer. Nitrates increase in the winter months and coarse mass increases slightly in the summer. Organic matter clearly dominates the other haze species on worst days, but nitrates, sulfates, and coarse mass also contribute to the worst days throughout the year. There are only trace amounts of soil and sea salt present throughout the years.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for organic matter, nitrates, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2003

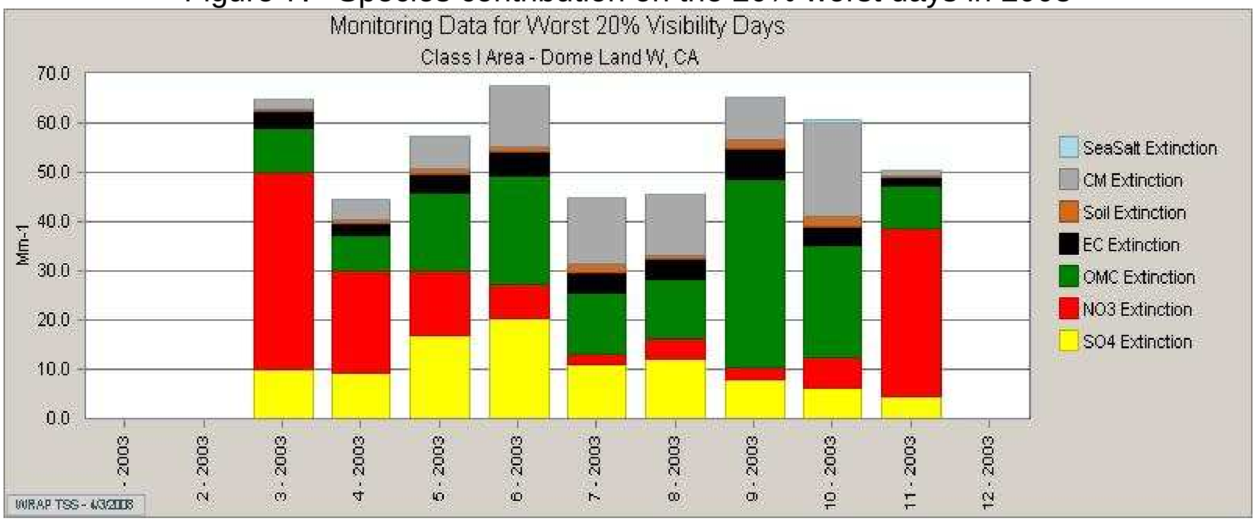
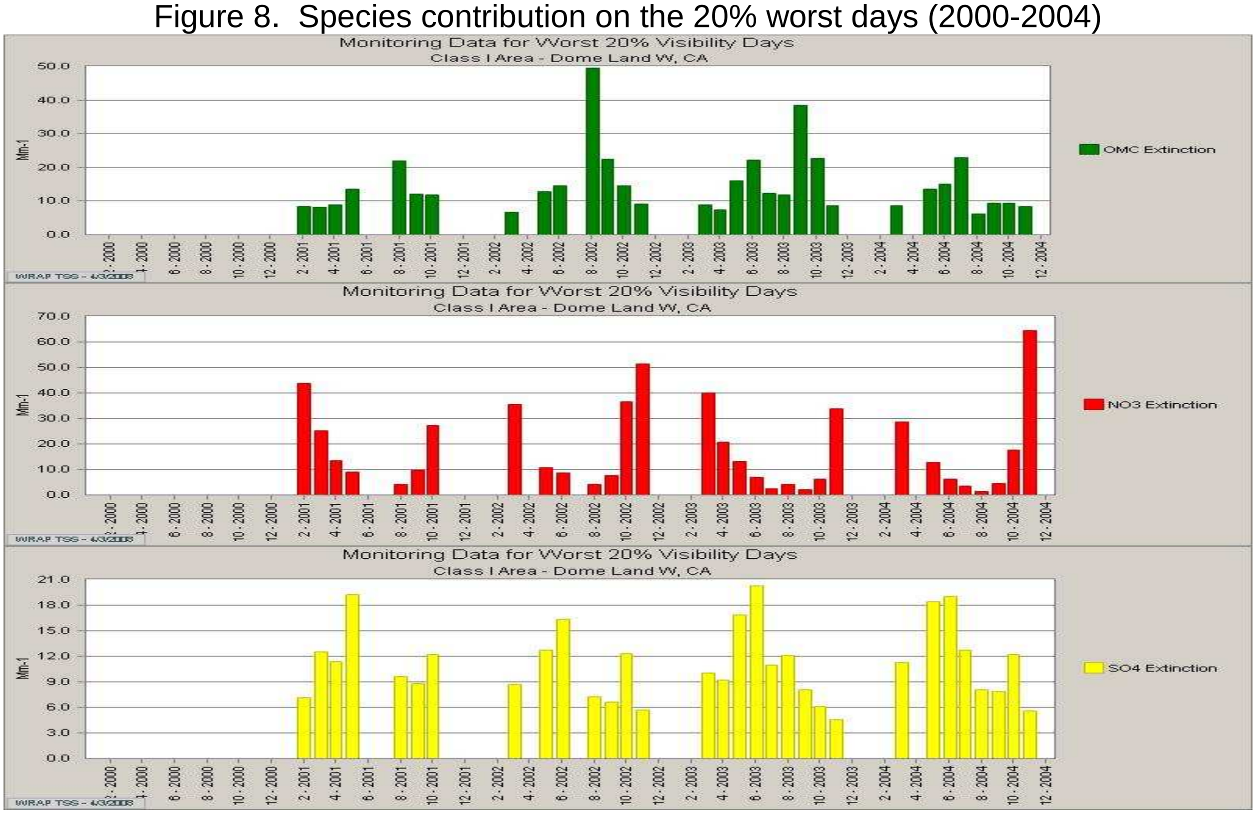


Figure 8. Species contribution on the 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at DOME1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 9 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the DOME1 monitor is from natural fire sources within California. California represents 99% of all natural fire source contributions.

Figure 10 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary emissions account for 67% of the total organic carbon. Biogenic secondary source emissions account for 31% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 11 and 12 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (86%), followed by the Outside Domain Region (11%) and emissions from Pacific Offshore (3%). Mobile sources within California contribute the most nitrates at the DOME1 monitor. In 2002, 81% of the nitrate at the DOME1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most to nitrate concentrations at the DOME1 monitor in 2002 and 2018. Currently, California mobile sources are 68% of California contributions to nitrate at the DOME1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figures 13 and 14 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at DOME1. The Outside Domain region represents 42% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (38%) and the Pacific Offshore Region (15%). California contributes 26% of the total sulfate emissions seen at the DOME1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the DOME1 monitor. The next largest contributor to sulfate concentration is area sources in the Pacific Offshore.

Figure 9. Organic carbon source contribution from CA and outside regions

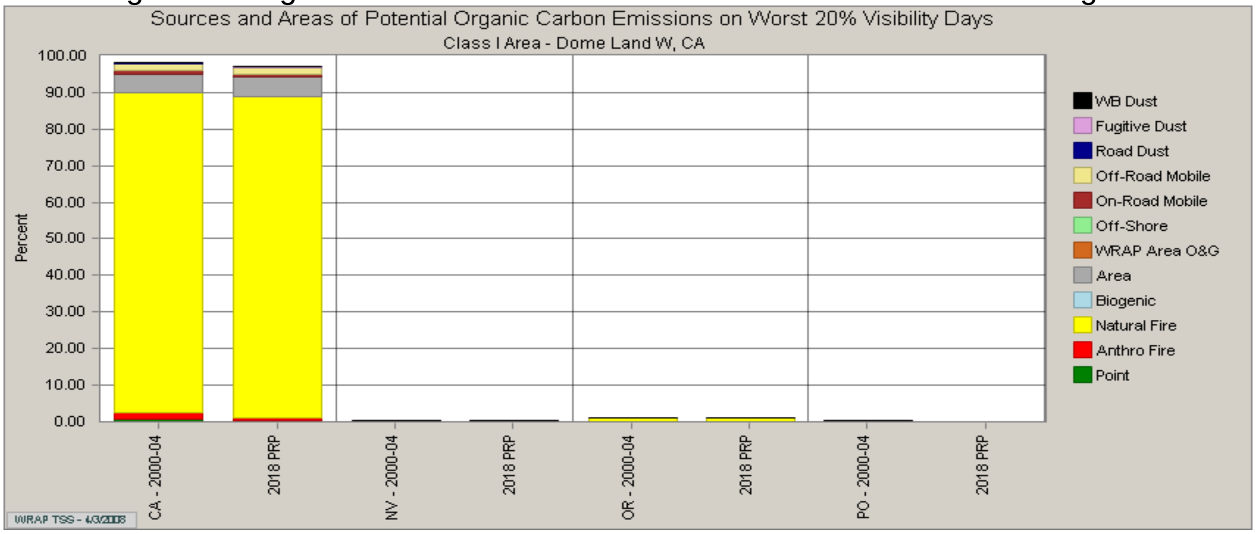


Figure 10. Organic carbon Anthropogenic and Biogenic Source Apportionment

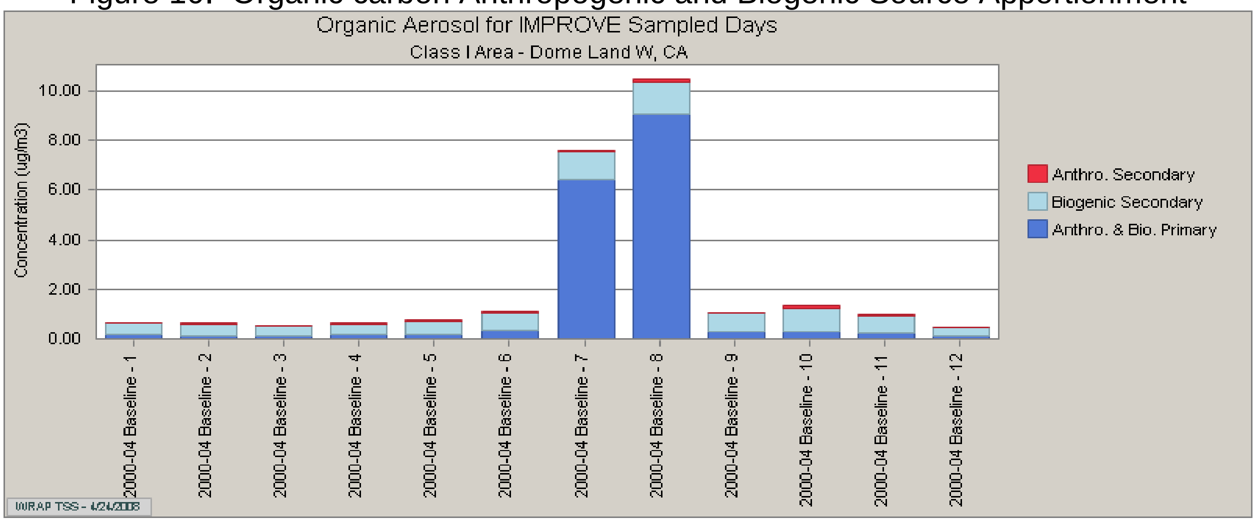


Figure 11. Regional Nitrate contribution to haze in 2002 and 2018

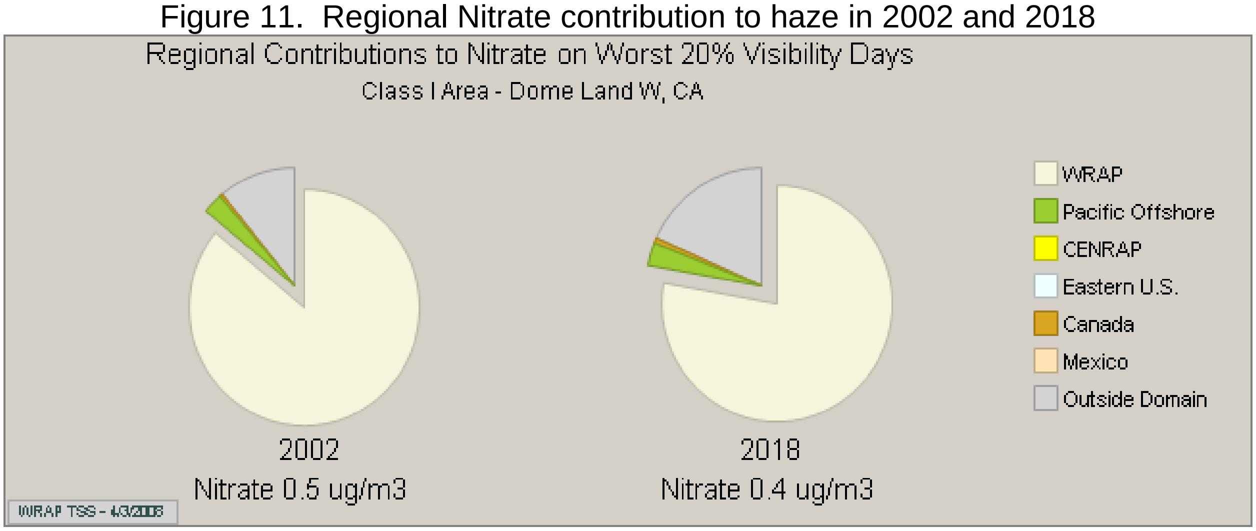


Figure 12. Nitrate source contribution from CA and outside regions

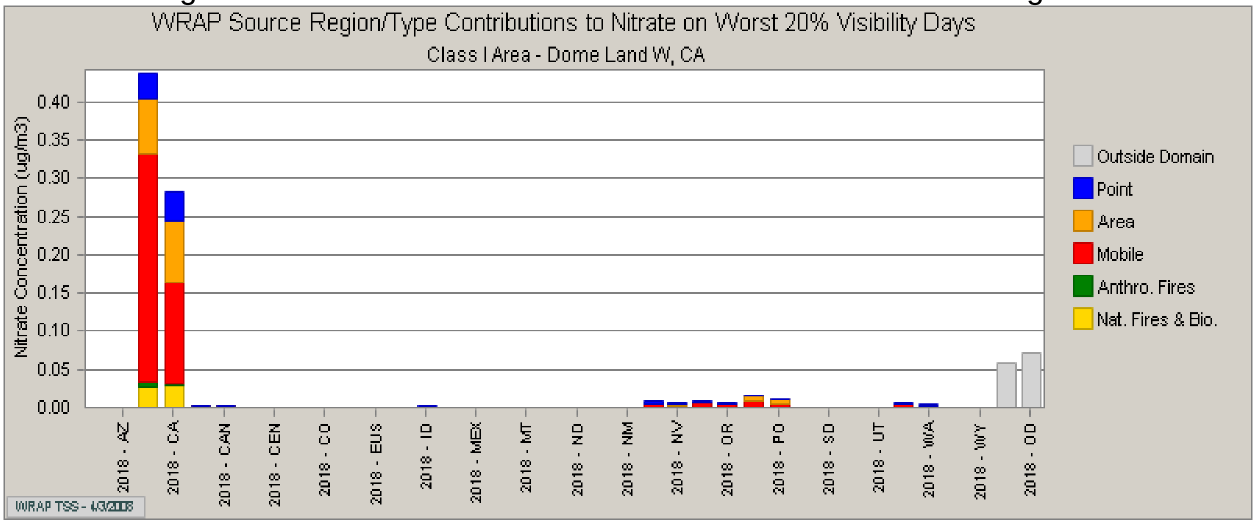


Figure 13. Regional Sulfate contribution to Haze in 2002 and 2018

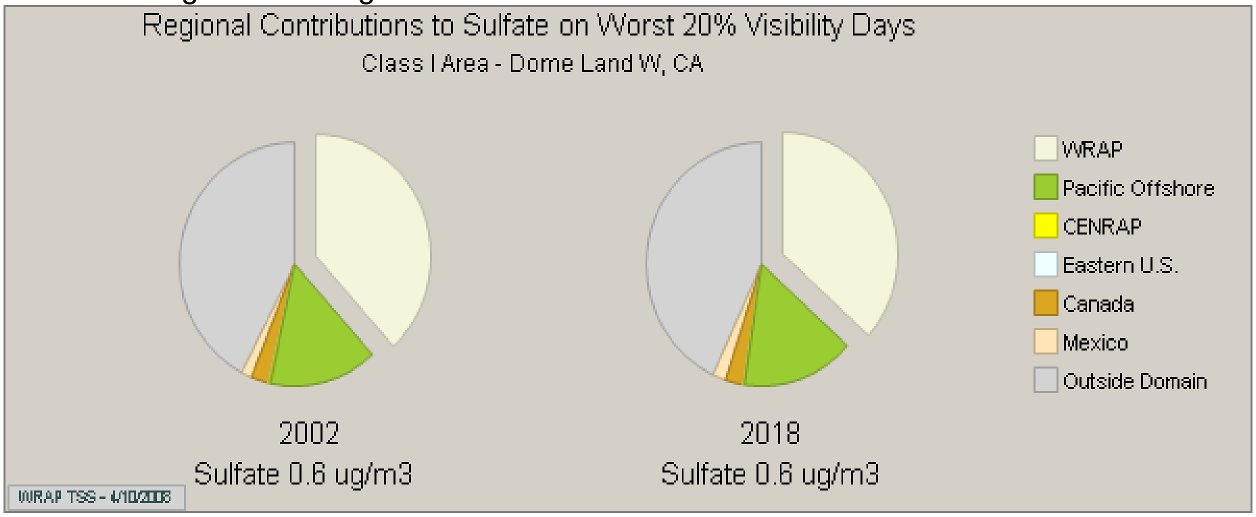
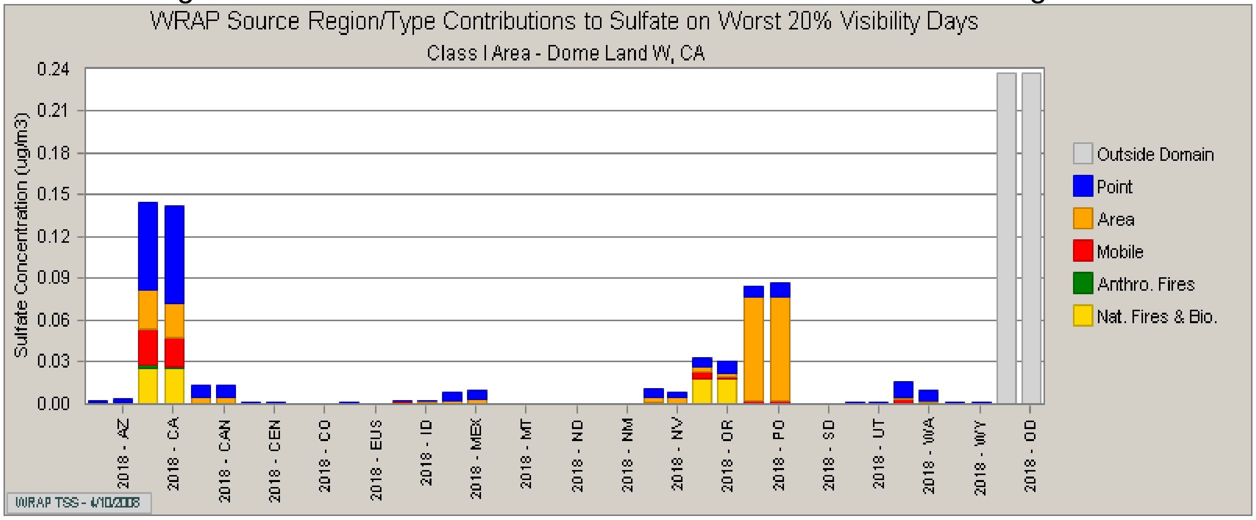


Figure 14. Sulfate source contribution from CA and outside regions



REDW1 Monitor

Section I. Description

Redwood National Park (Redwoods) consists of 27,792 acres of coast and coastal mountains in northern California. The several unconnected sections of the Park include 37 miles of coastline between the Oregon border and McKinleyville, California. Elevations range from sea level to about 914 meters. As part of the coast ranges that present the first obstruction to moist air from the Pacific, it has a relatively high annual average precipitation. Total annual precipitation on the northern California coast is about 120 inches, mostly during the winter when the Aleutian Low is at its most southerly position over the eastern Pacific. Precipitation varies considerably with inland distance and with elevation. The furthest inland extent of Redwoods is about 15 miles from the coast. Besides the coast and mountains, the most significant topographic features are the Smith and Klamath Rivers that empty into the Pacific in the northern and southern Redwoods areas, respectively.

Figure 1. REDW1 Monitor location

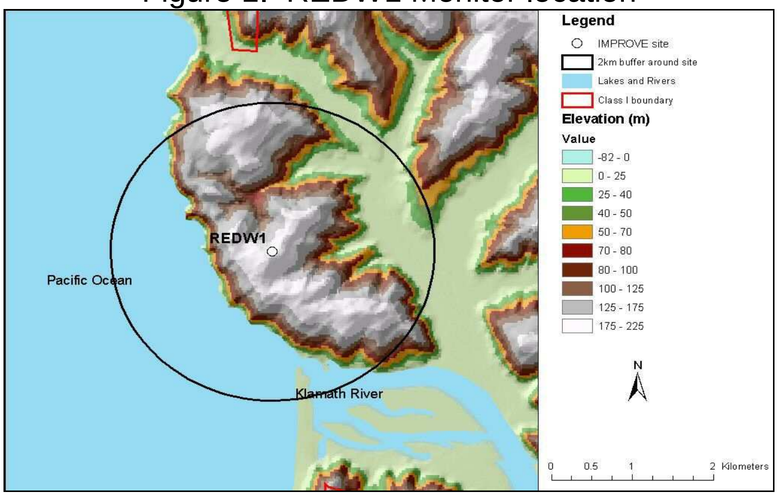
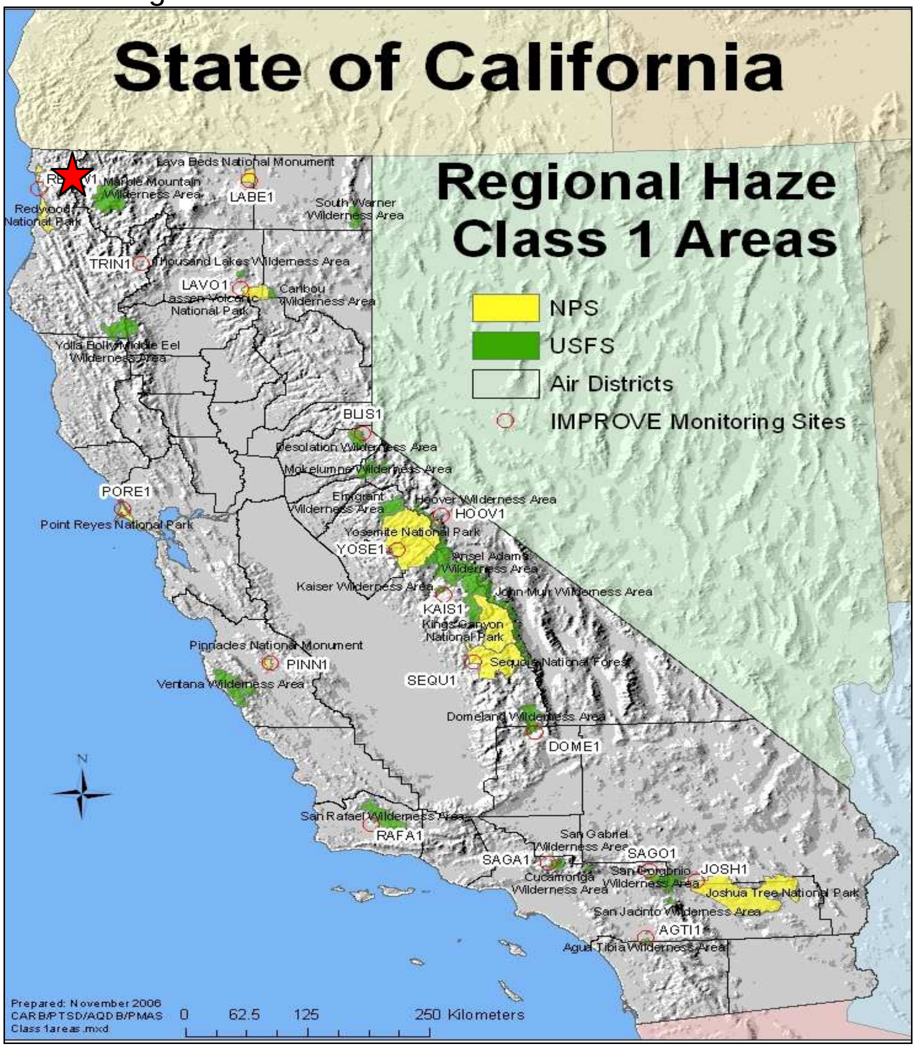


Figure 2. Image taken from Redwood monitor camera

Figure 3. REDW1 Monitor location in California



Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for Redwoods are currently monitored by the REDW1 IMPROVE monitor. The monitor is located at 41.5608 north latitude and 124.0839 west longitude, located outside of park boundaries, but in a central location with respect to Redwood park sections. It is near the mouth of the Klamath River at an elevation of 244 meters. The site has been operating since March 1988. This site has sufficient data for the five baseline years of 2000 – 2004.

The REDW1 IMPROVE site is centrally located with respect to Park locations at a midrange elevation and should be quite representative of aerosol concentration and composition within Redwoods. There may be some modest influence by airflow down the Klamath River, which may be a transport route for emissions from the interior such as wildfire emissions that could influence measurements at the monitoring site locally.

The nearest population center is the Crescent City area near the mouth of the Smith River and the northern boundary of Redwoods.

The REDW1 location is adequate for assessing the 2018 reasonable progress goals for the Redwood National Park Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from REDW1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the Redwood National Forest is calculated at 6.1 deciviews for the 20% best days and 18.5 deciviews for the 20% worst days. Figure 4 represents the worst baseline visibility conditions.

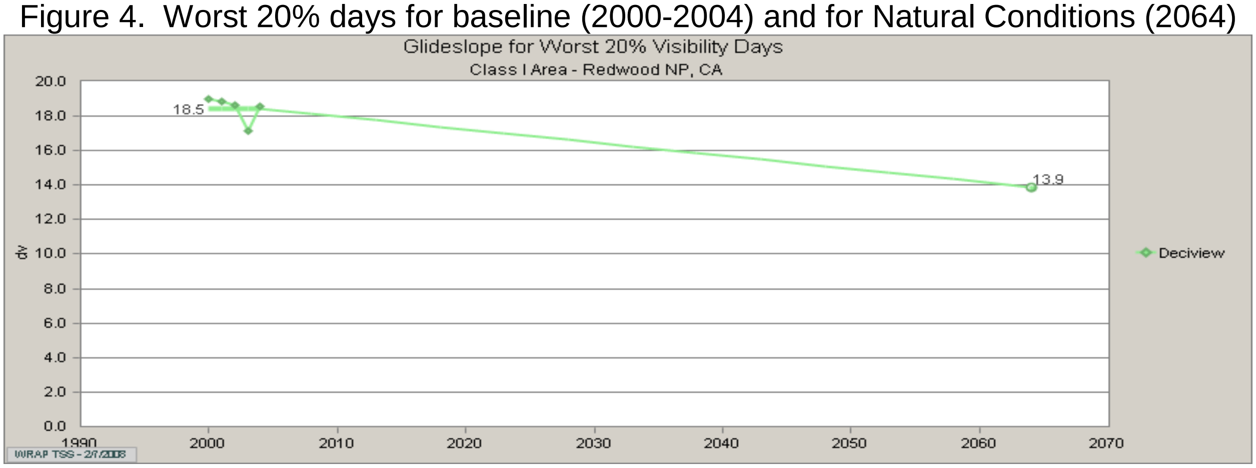
II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the Redwood National Forest is 3.5 deciviews for the 20% best days and 13.9 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 4 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 17.39 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 6.1 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at REDW1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

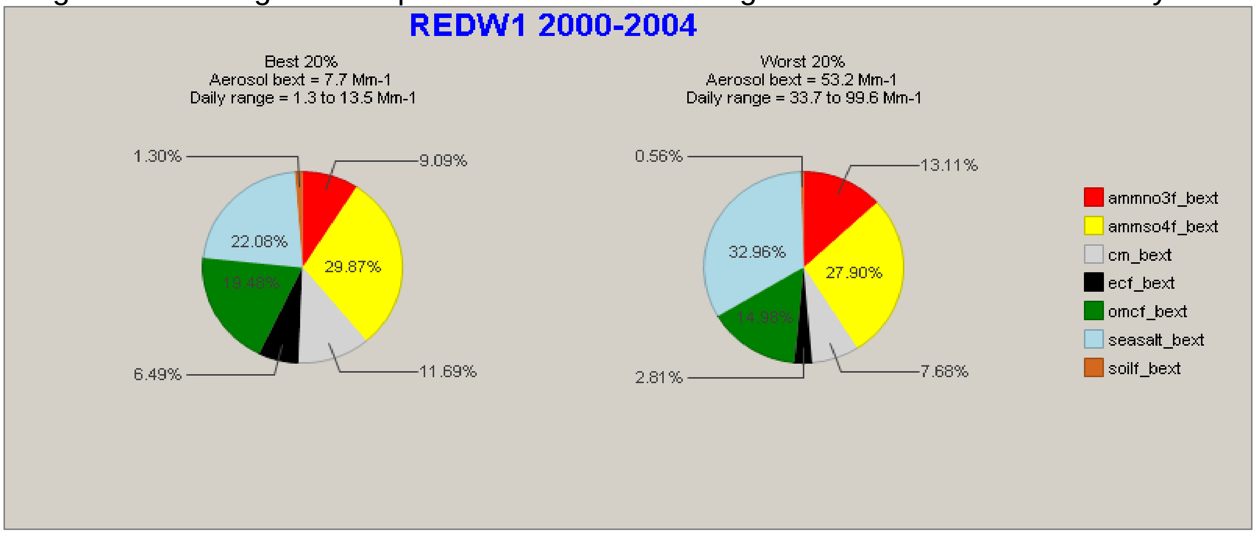
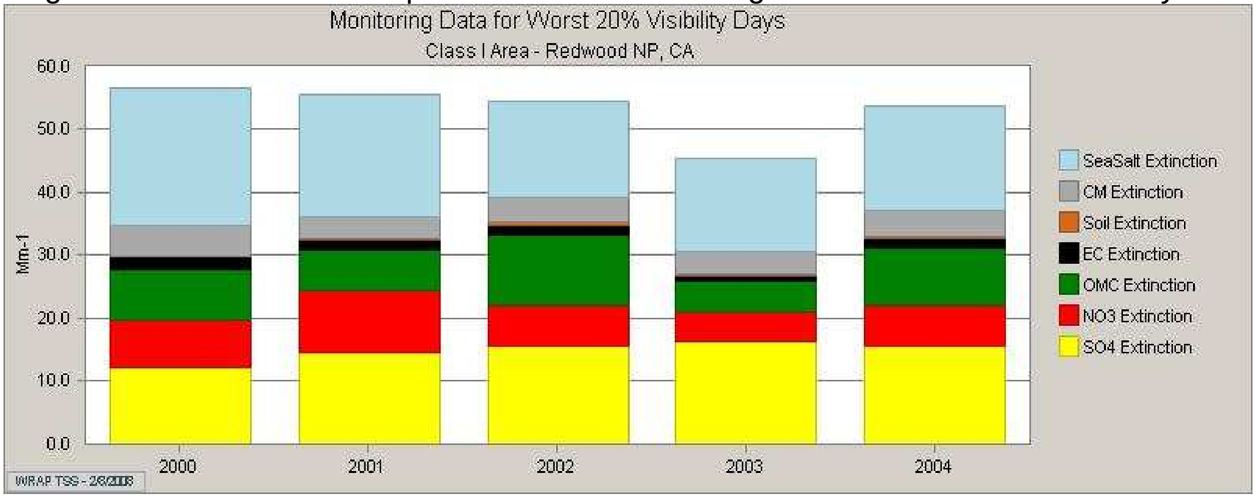


Figure 6. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, sea salt, sulfates, and organic matter have the strongest contributions to degrading visibility on worst days at Redwood National Park. The worst days are dominated by sea salt, while the best days are dominated by sulfate.

Figure 7 depicts the individual species contribution to worst days in 2002. Sea salt and sulfate increase in the summer months while organic matter increases in the winter months. Sea salt clearly dominates the other haze species on worst days, but sulfates, organic carbon, nitrates, and coarse mass also contribute to the worst days. Elemental carbon and soil are present in trace amounts at the REDW1 monitor.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for sea salt, sulfates, organic matter, and nitrates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2002

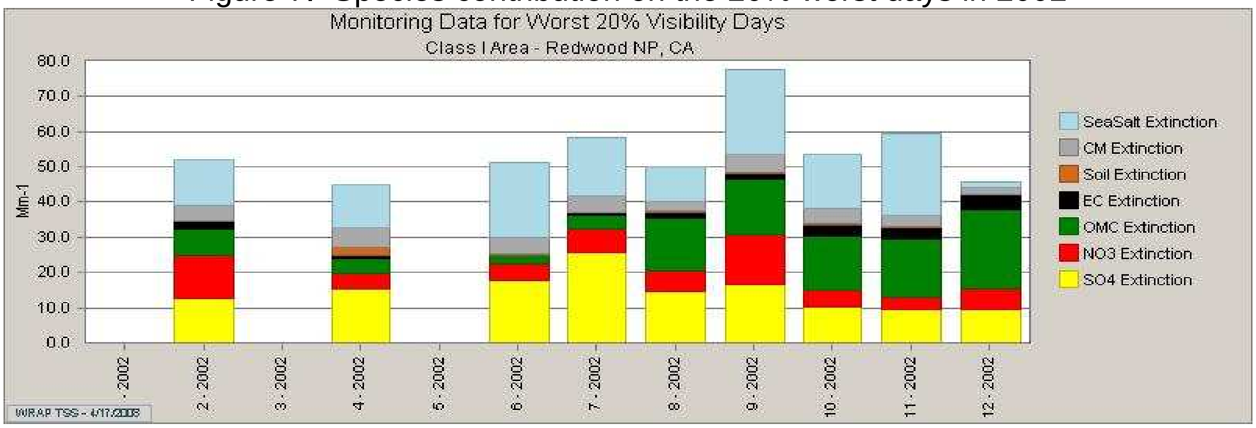
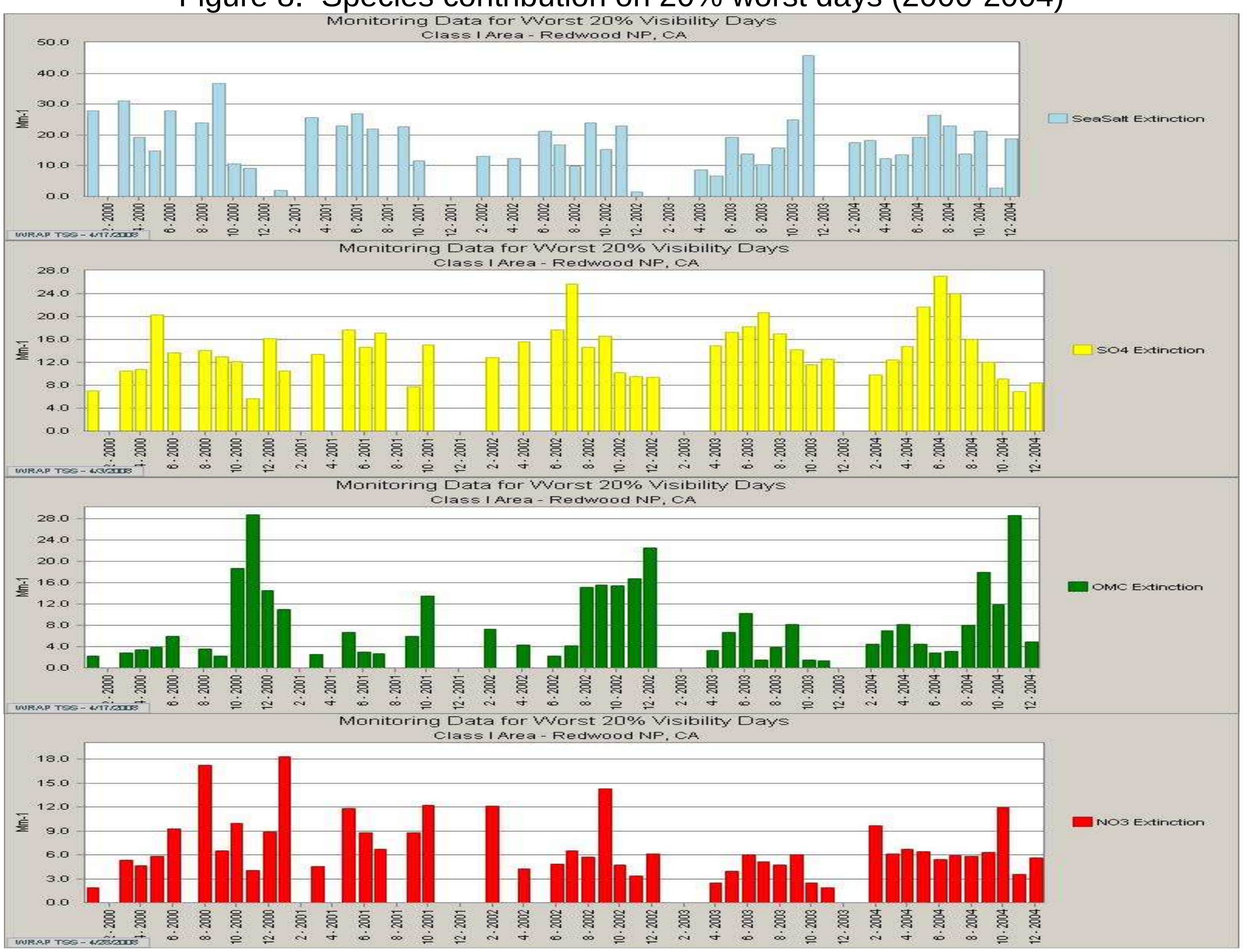


Figure 8. Species contribution on 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at REDW1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figure 9 illustrates the glide slope for the 20% worst visibility days at the REDW1 monitor. Sea salt are the only emissions that actually increase by 2064. This is because as anthropogenic emissions are removed, sea salt will play a larger role in contributing to the haze seen at the REDW1 monitor.

Figures 10 and 11 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at REDW1. The Outside Domain region represents 51% of the sulfate contributions in 2002 and 2018, followed by the emissions from the Pacific Offshore Region (23%) and the WRAP Region (23%). California contributes 1% of the total sulfate emissions seen at the REDW1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the REDW1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore Region.

Figure 12 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the REDW1 monitor is from natural fire sources within Oregon. Oregon represents 95% of all natural fire source contributions.

Figure 13 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The biogenic secondary emissions account for 52% of the total organic carbon. Anthropogenic and biogenic primary source emissions account for 46% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 14 and 15 represent the regional contributions to nitrate on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (50%), followed by the Pacific Offshore Region (28%) and emissions from outside the modeling domain (20%). In 2002, 8% of the nitrate at the REDW1 monitor can be attributed to California.

From the WRAP region, Oregon is shown to contribute the most to nitrate concentrations at the REDW1 monitor in 2002 and 2018. Currently, Oregon mobile sources are 75% of Oregon contributions to nitrate at the REDW1 monitor. Oregon mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 9. REDW1 Glide slope for 20% worst visibility days

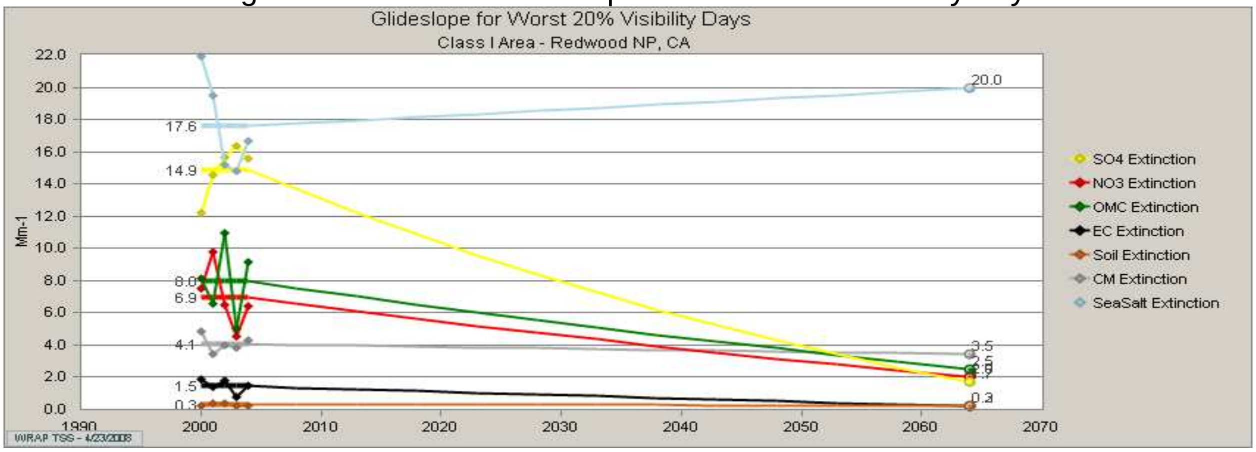


Figure 10. Regional Sulfate contribution to haze in 2002 and 2018

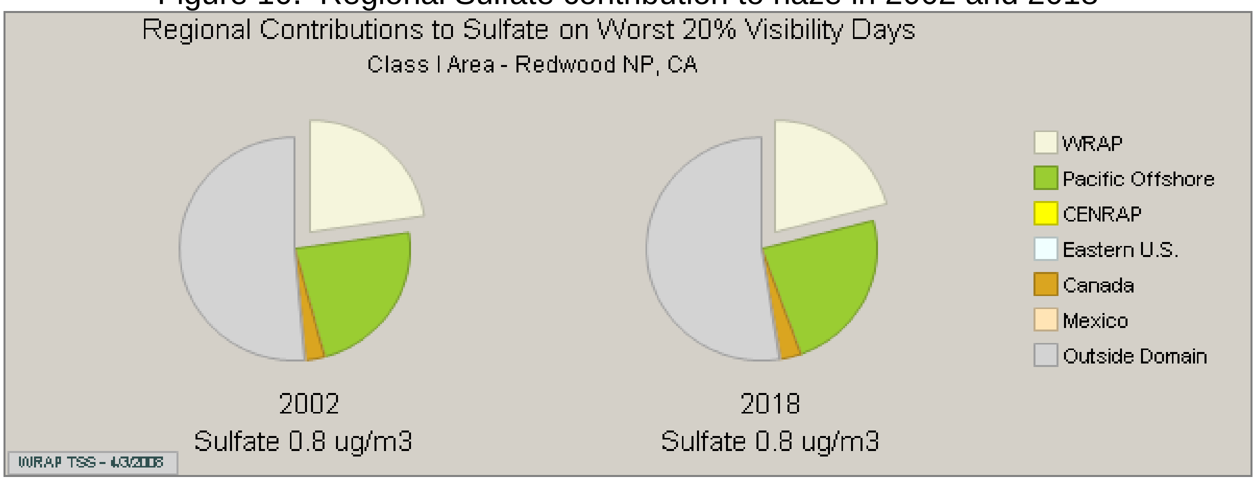


Figure 11. Sulfate source contribution from CA and outside regions

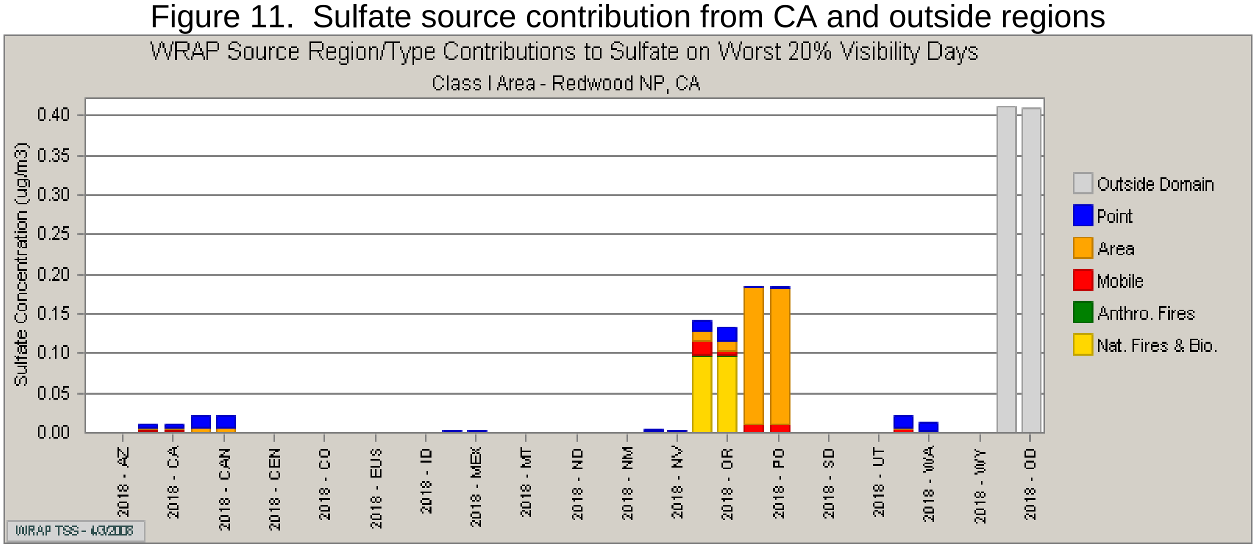


Figure 12. Organic carbon source contribution from CA and outside regions

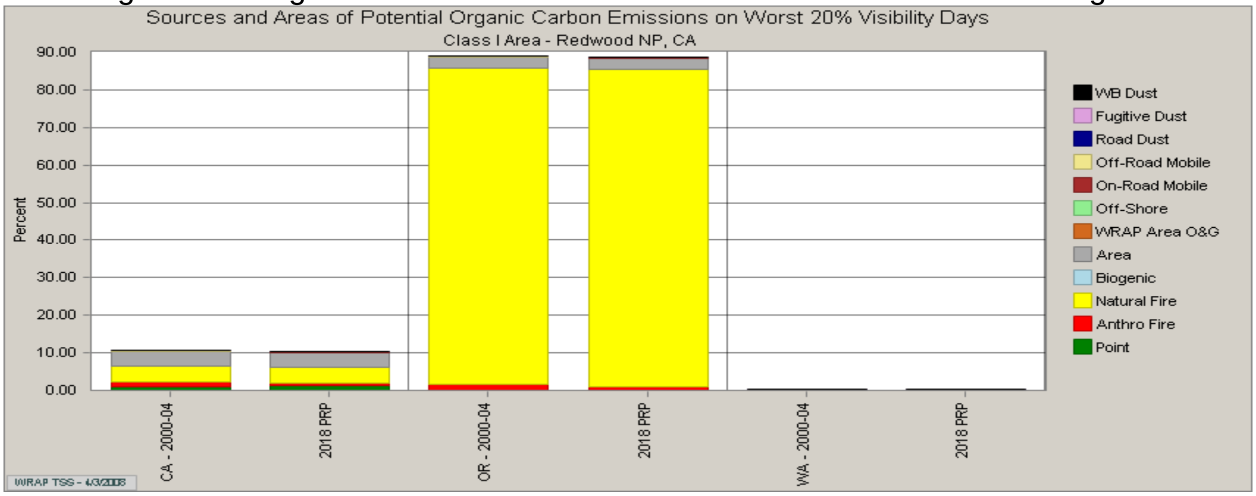


Figure 13. Organic carbon Anthropogenic and Biogenic source apportionment

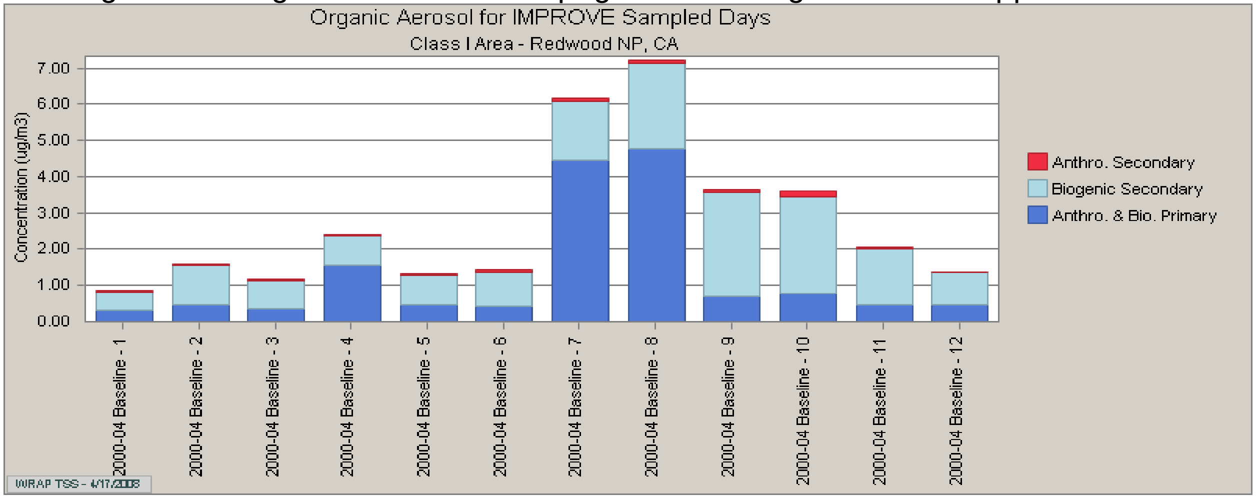


Figure 14. Regional Nitrate contribution to haze in 2002 and 2018

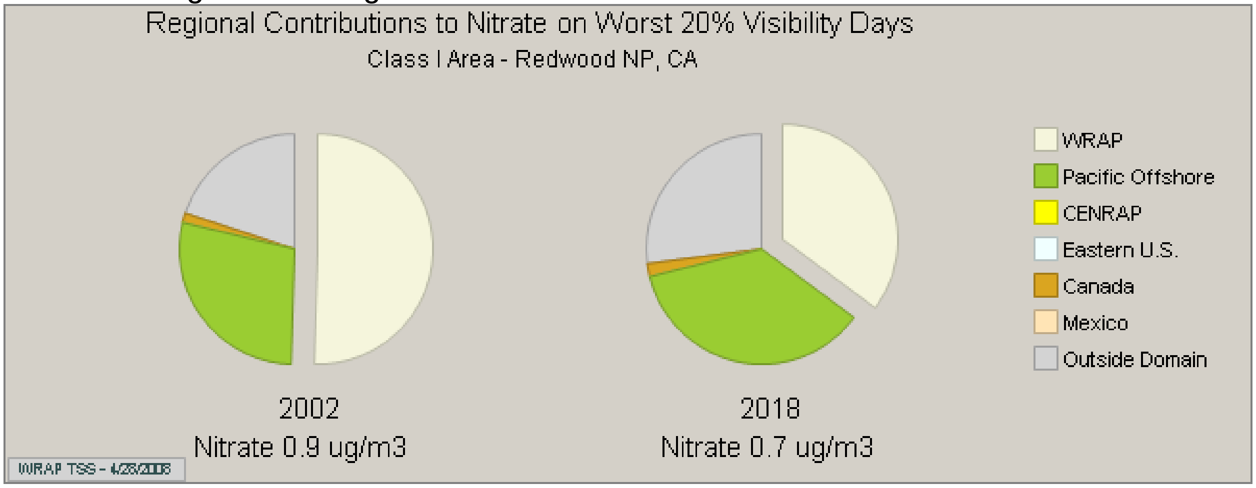
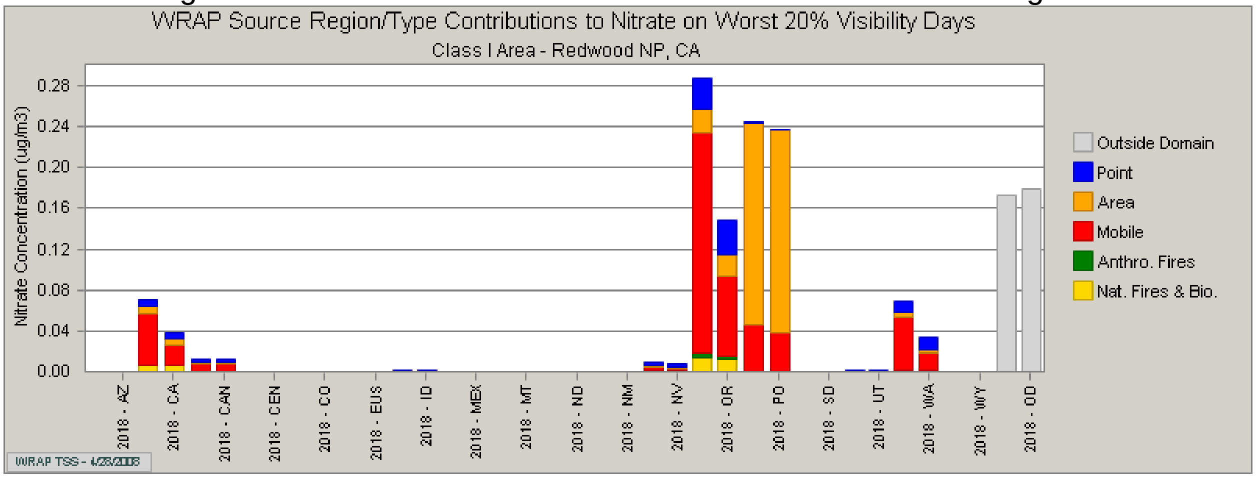


Figure 15. Nitrate source contribution from CA and outside regions



PORE1 Monitor

Section I. Description

Point Reyes Wilderness Area (Point Reyes) occupies 25,370 acres within the Point Reyes National Seashore situated just north of San Francisco. Point Reyes National Seashore is a peninsula that extends into the Pacific Ocean about 12 miles from the California mainland. The Wilderness consists primarily of the complex terrain section of the peninsula east of and parallel to Highway 1, with elevations ranging from sea level to nearly 427 meters at highest hilltops. The land is composed of estuaries, windswept beaches, coastal scrub grasslands, marshes, and some coniferous forest at higher elevations.

Figure 1. PORE1 Monitor location

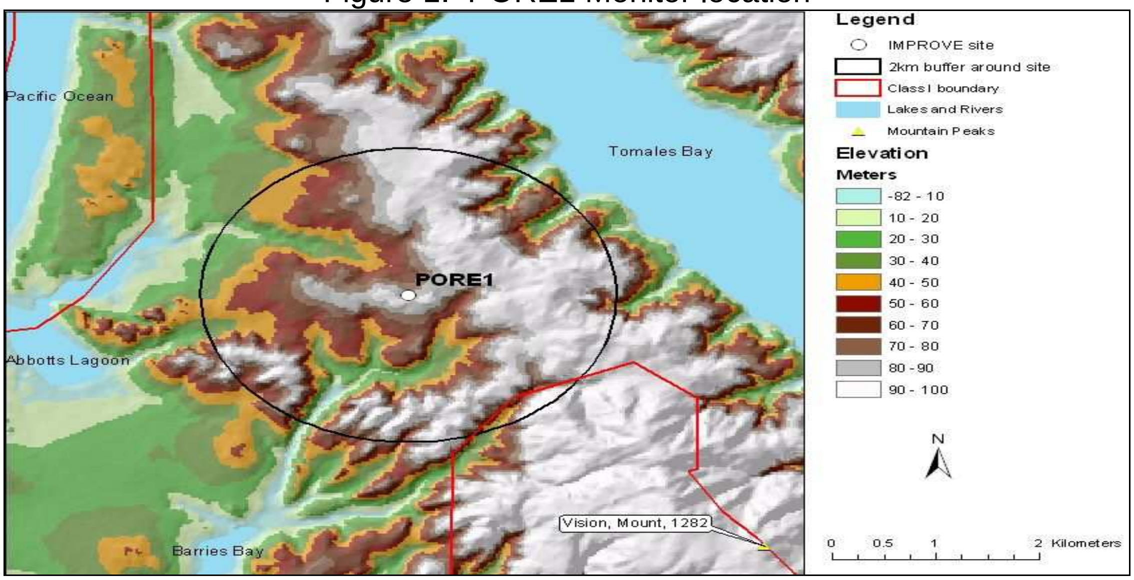


Figure 2. WINHAZE image of Point Reyes Wilderness Area (10.5 vs. 22.8 dv)

Figure 3. PORE Monitor location in California

Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for Point Reyes are currently monitored by the PORE1 IMPROVE monitor. The monitor is located at 38.1224 north latitude and 122.9085 west longitude, and located in the center of three distinct areas of the wilderness at an elevation of 97 meters. The site has been operating since March 1988. This site does not have sufficient data for the entire baseline period. Data was not available for the years 2001 and 2003.

The PORE1 IMPROVE site is located centrally within the small range of Wilderness elevations. It is very representative of aerosol composition and concentration at Point Reyes Wilderness locations. The nearest major population and industrial center is the San Francisco Bay area to which Point Reyes is almost adjacent but separated from by the Marin Peninsula north of the Golden Gate. Downtown San Francisco is about 20 miles to the south. North Bay communities of Petaluma and San Rafael are about 15 miles east, on the east side of the Bolinas Ridge.

The PORE1 location is adequate for assessing the 2018 reasonable progress goals for the Point Reyes Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from PORE1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the Point Reyes Wilderness Area is calculated at 10.5 deciviews for the 20% best days and 22.8 deciviews for the 20% worst days. Figure 3 represents the worst baseline visibility conditions.

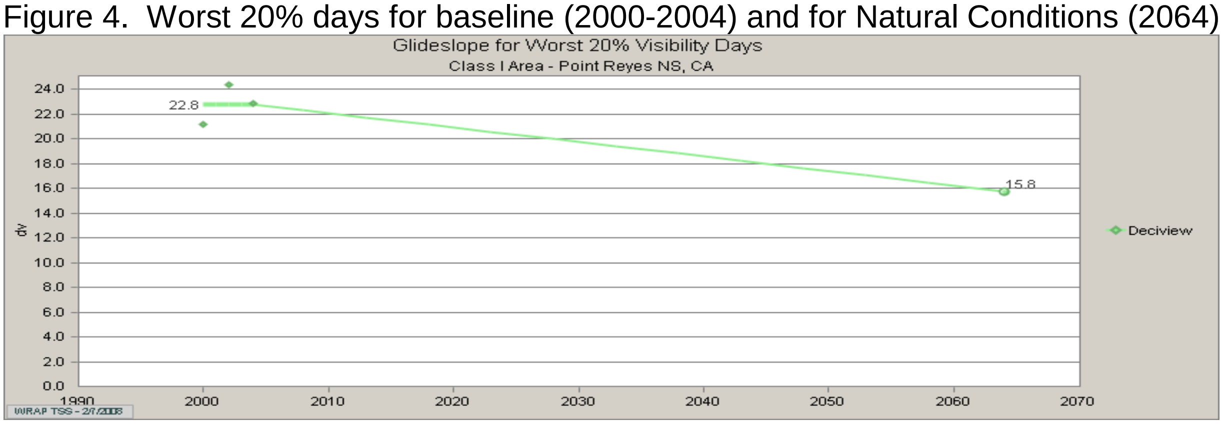
II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the Point Reyes Wilderness Area is 4.8 deciviews for the 20% best days and 15.8 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 3 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 21.17 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 10.5 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at PORE1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

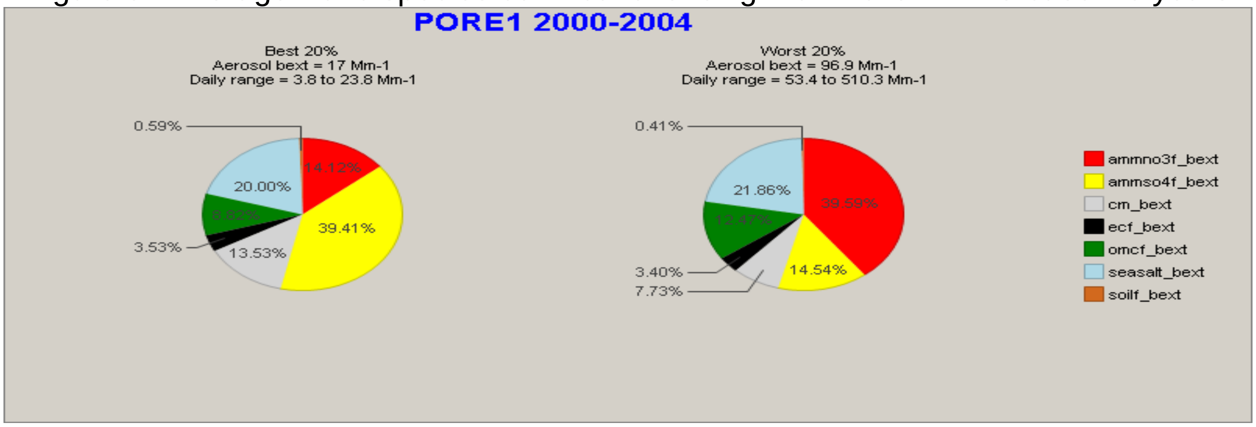
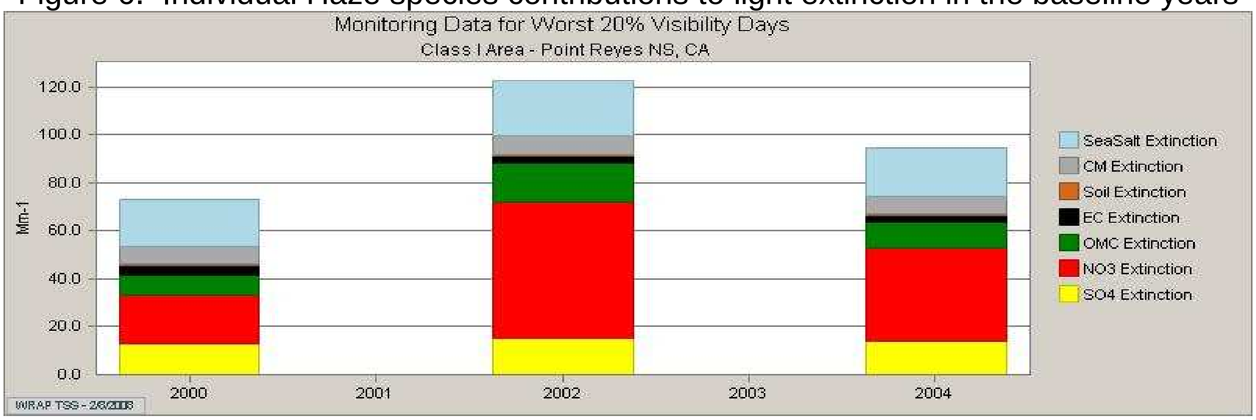


Figure 6. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, nitrates, sea salt, and sulfates have the strongest contributions to degrading visibility on worst days at Point Reyes Wilderness Area. The worst days are dominated by nitrate, while the best days are dominated by sulfate. Data points for 2001 and 2003 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 7 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter months and sea salt is always present but peaks in the months of March-June. The worst days occur when sea salt is elevated. Sulfates are slightly higher in the summer and they almost double from best to worst days. The occurrence of elevated organic matter concentrations is sporadic throughout the year. Sea salt is driving the worst days for most of the year in 2002. Nitrates clearly dominate the other haze species on worst days, but sea salt, sulfate, and organic matter also contribute to the worst days in the summer. There are only trace amounts of coarse mass and elemental carbon present throughout the years.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for sea salt, nitrates, sulfates, and organic matter. High organic periods vary from year to year due to the unpredictable occurrence of wild fires. For example, the elevated organic carbon concentrations in August 2002 can be attributed to the Biscuit Fire that burned extensive acreage in Southern Oregon and Northern California.

Figure 7. Species contribution on the 20% worst days in 2002

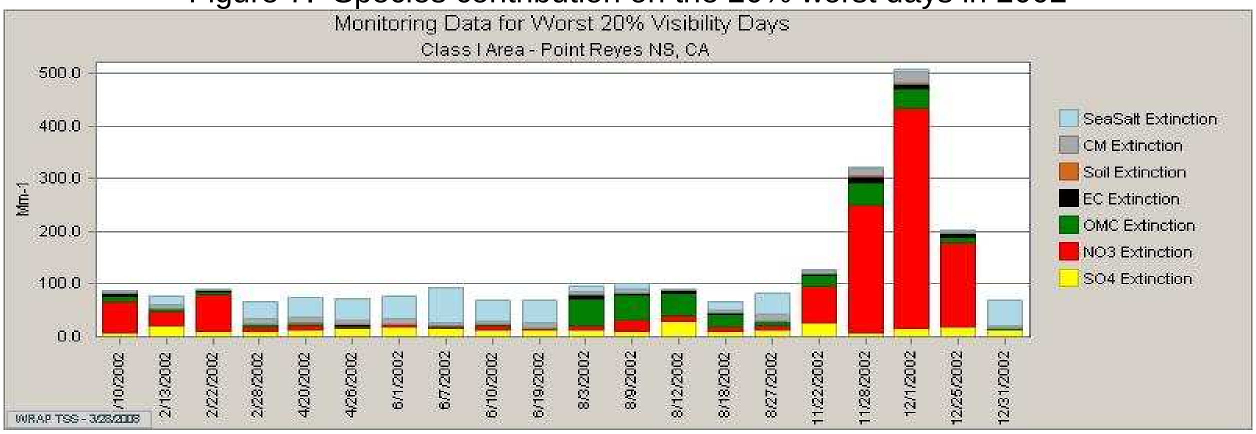
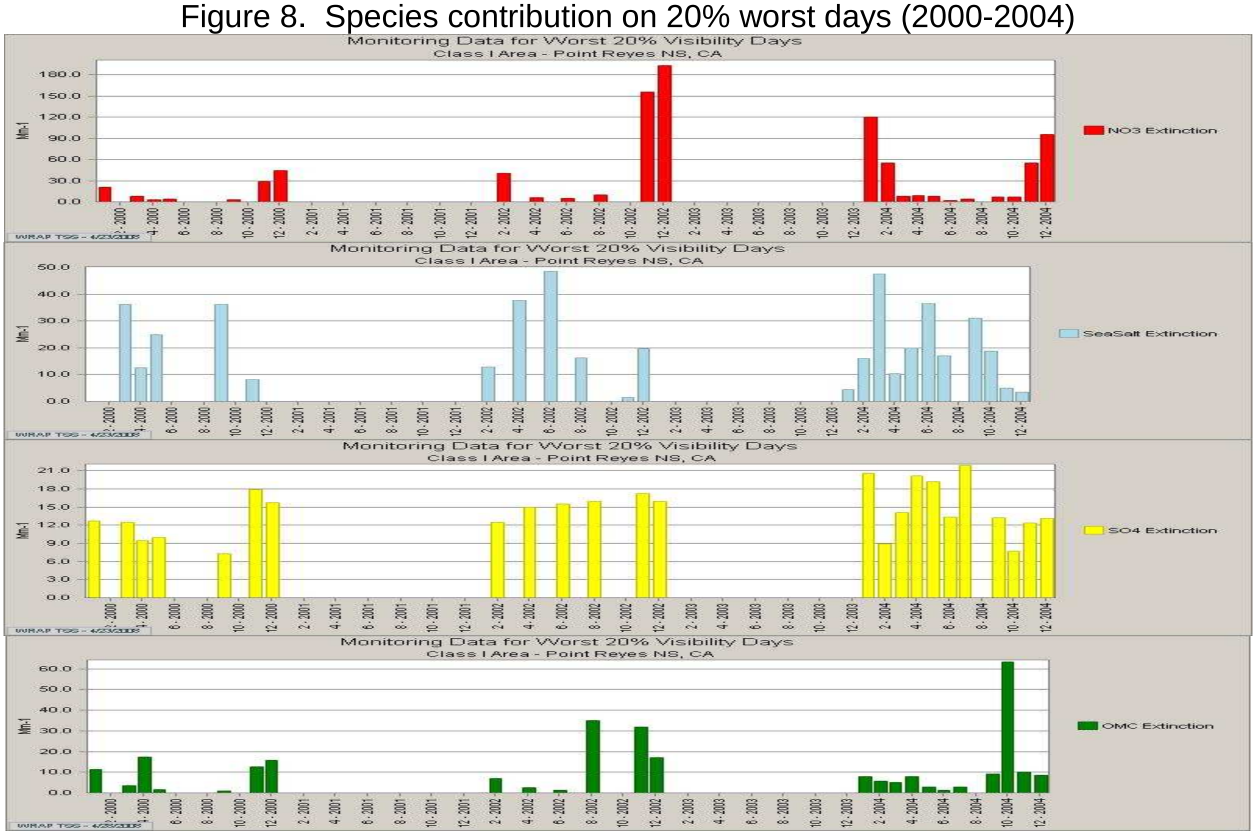


Figure 8. Species contribution on 20% worst days (2000-2004)



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II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at PORE1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 9 and 10 represent the regional contributions to nitrate on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (85%), followed by the Pacific Offshore Region (9%) and emissions from outside the modeling domain (6%). In 2002, 76% of the nitrate at the PORE monitor can be attributed to California.

From the WRAP region, California is shown to contribute the most to nitrate concentrations at the PORE monitor in 2002 and 2018. Currently, California mobile sources are 75% of California contributions to nitrate at the PORE monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 11 illustrates the 20% worst visibility days at the PORE1 monitor. Sea salt emissions are the only source that actually increases in 2064. This is because as anthropogenic emissions are removed, sea salt will play a larger role in contributing to the haze seen at the PORE1 monitor.

Figures 12 and 13 represent the regional contributions of sulfate on the 20% worst days in 2002 and 2018 at PORE. The WRAP region represents 38% of the sulfate contributions in 2002 and 2018, followed by the emissions from outside the domain (35%) and the Pacific Offshore Region (23%). California contributes 17% of the total sulfate emissions seen at the PORE1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the PORE1 monitor. The next largest contributor to sulfate concentration is from area sources in the Pacific Offshore Region.

Figure 14 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the PORE1 monitor is from area sources within California. California represents 92% of all area source contributions.

Figure 15 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 57% of the total organic carbon. Biogenic secondary emissions account for 39% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figure 9. Regional Nitrate Contribution to Haze in 2002 and 2018

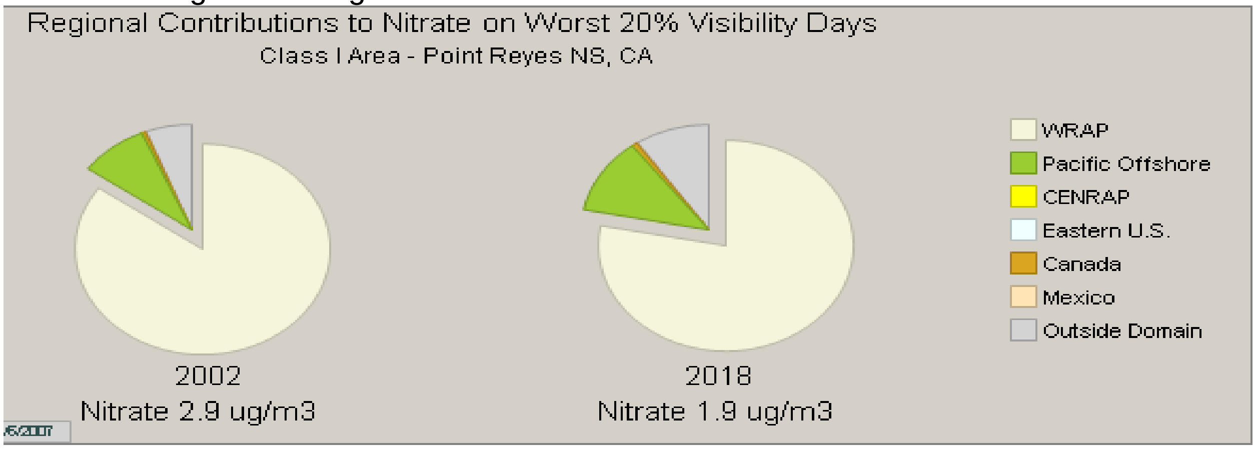


Figure 10. Nitrate source contribution from CA and outside regions

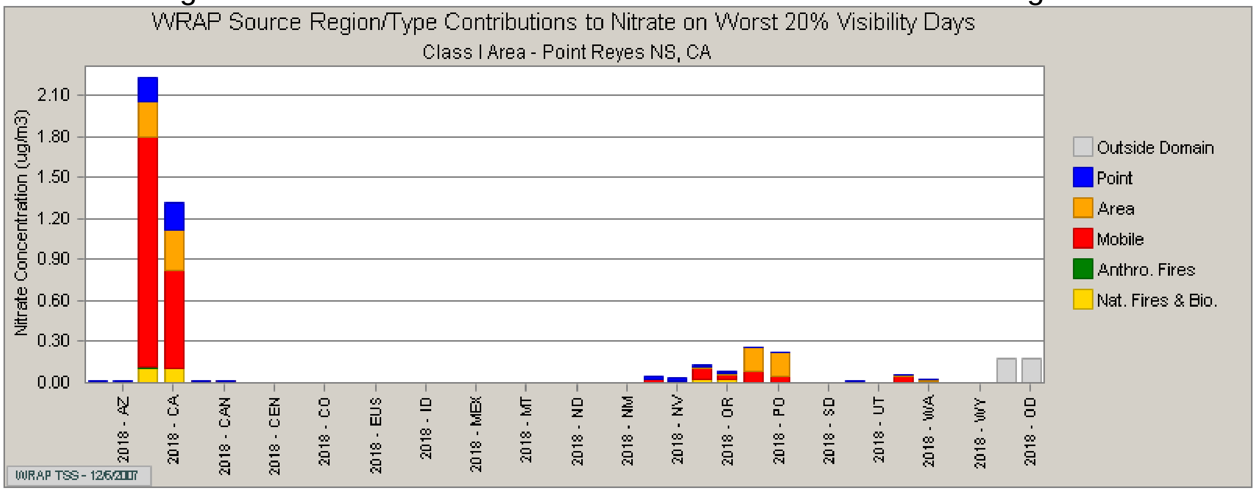


Figure 11. PORE1 glide slope for the 20% worst visibility days

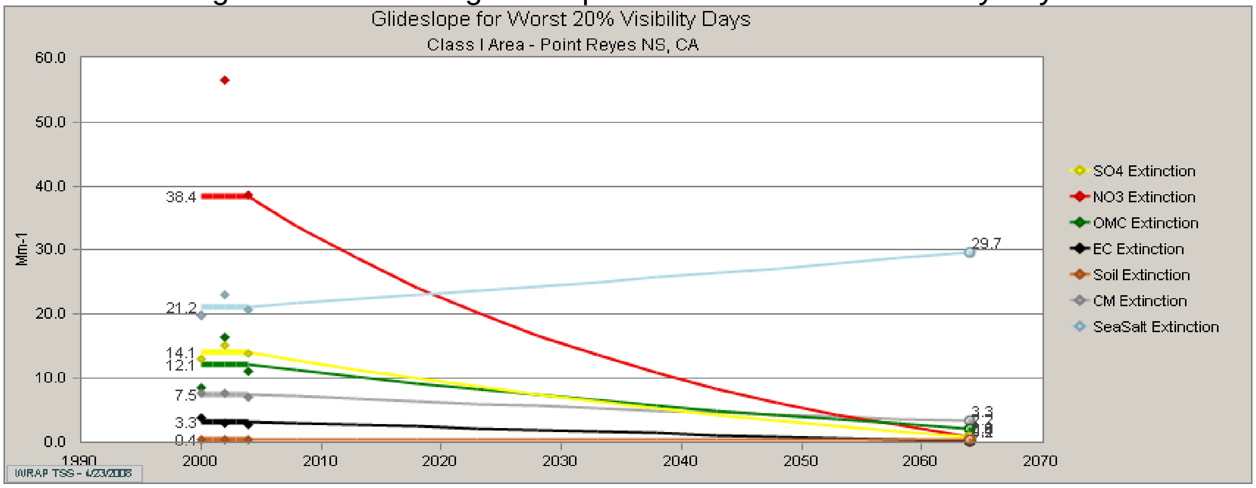


Figure 12. Regional Sulfate Contribution to Haze in 2002 and 2018

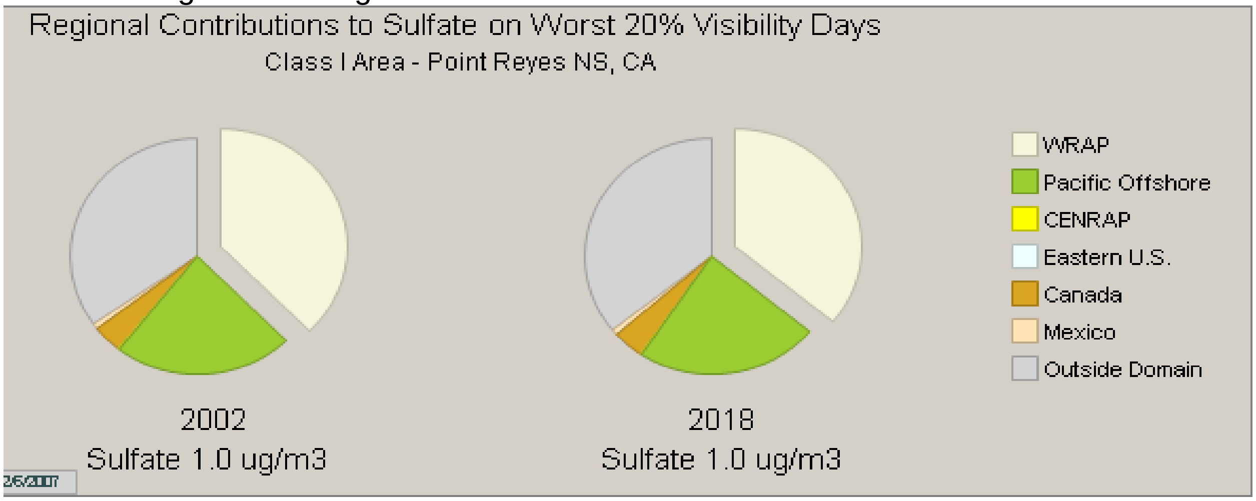


Figure 13. Sulfate source contribution from CA and outside regions

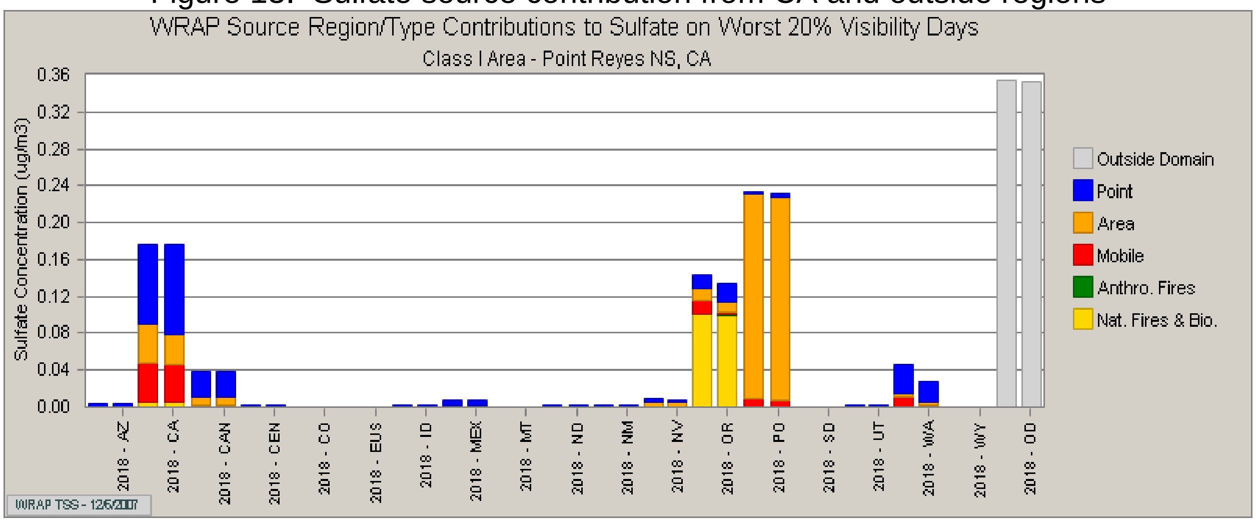


Figure 14. Organic carbon source contribution from CA and outside regions

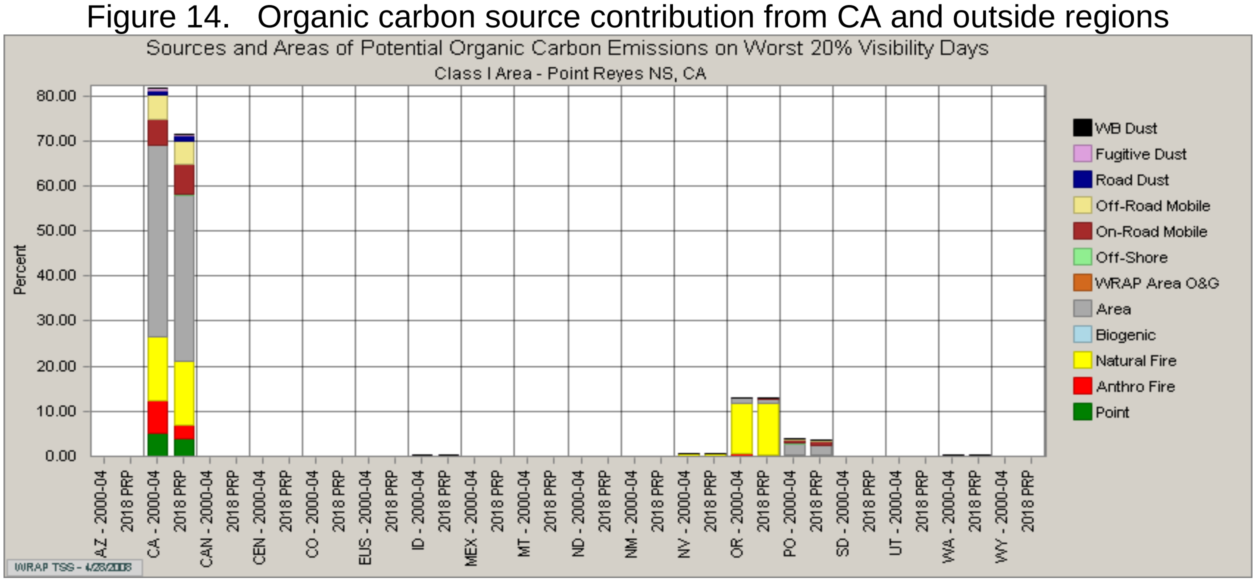
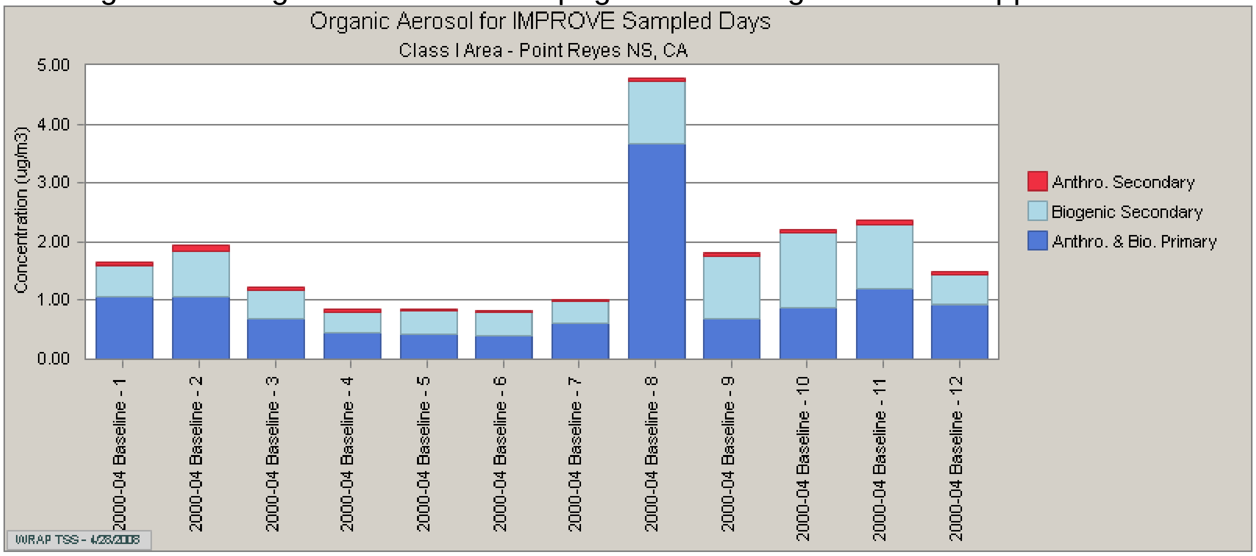


Figure 15. Organic carbon Anthropogenic and Biogenic source apportionment



PINN1 Monitor

The PINN1 monitor location represents two wilderness areas located near the Central Coast Range in California. The wilderness areas associated with the PINN1 monitor are Pinnacles National Monument and Ventana Wilderness area. The PINN1 site has been operating since March 1988. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2001.

Section I. PINN1 Wilderness Area Descriptions

I.a. Pinnacles Wilderness Area

The Pinnacles Wilderness Area (Pinnacles) comprises 12,952 acres within the Pinnacles National Monument. Pinnacles is located in the southern portion of the Gabilan Mountains, one of a series of parallel northwest-southeast ridges that make up the Central Coast Range. Within the Wilderness Area, elevations range from 251 meters along South Chalone Creek to 1007 meters at North Chalone Peak. Much of the terrain is rolling hills. It is about 40 miles inland from the Pacific Ocean, with the Santa Lucia Mountains between, which modifies the Ocean's influence. The Gabilan range is bounded on the west by the Salinas Valley which provides a conduit to the Pacific coast near Monterey, 40 miles east. It is bounded on the east by the San Benito Valley which is the southern extension of the Santa Clara valley at the southern end of the San Francisco Bay area 60 miles to the north.

Figure 1. PINN1 Monitor location

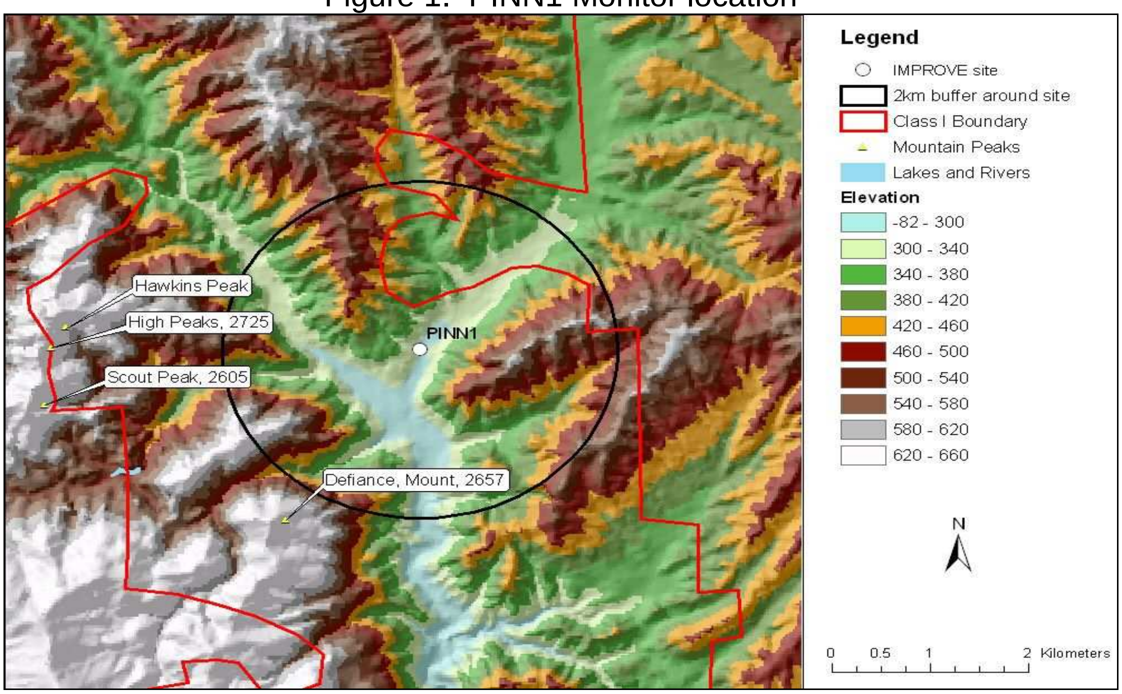
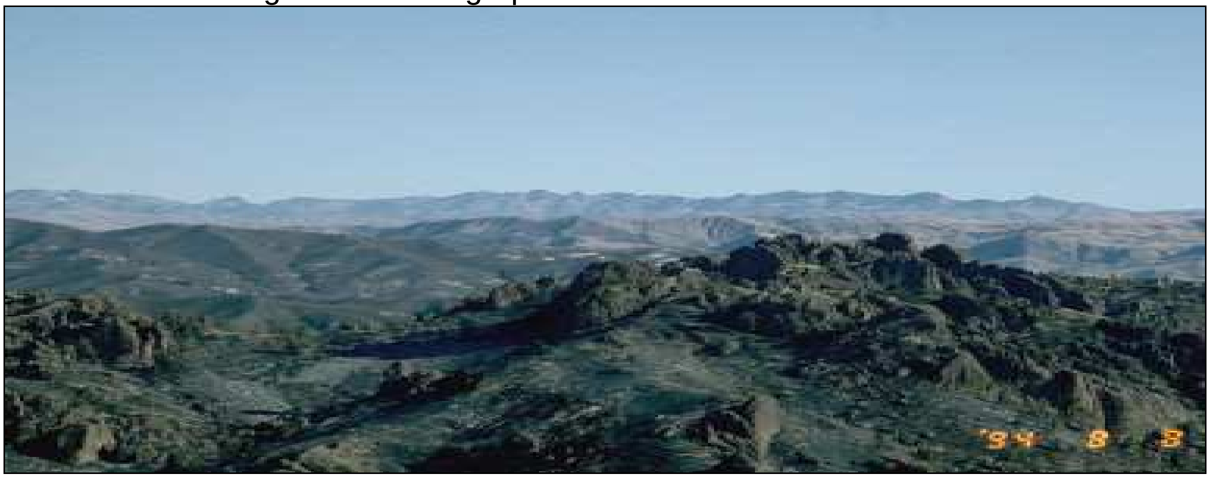


Figure 2. Photograph of Pinnacles Wilderness Area



I.b. Ventana Wilderness Area

The Ventana Wilderness Area (Ventana) consists of 95,152 acres straddling the Santa Lucia Mountains, about 15 miles south of Monterey Bay. The terrain is comprised of steep ridges and peaks. The Wilderness is in two sections, a large section consisting of most of the northwest Santa Lucias, and a smaller section to the southeast that includes Juniper Serra Peak. Elevations range from 183 meters where the Big Sur River exits the Wilderness on the west side, to 1,787 meters at the crest of Junipero Serra Peak, the highest point in the Santa Lucia range. The Santa Lucia range is the first barrier to westerly winds and presents a rain shadow over inland areas. Annual precipitation on the coast side totals up to 75 inches, mostly in the winter, with as little as 25 inches a few miles inland. Summertime fog can cover lower elevations on the west side, but seldom reaches more than a few miles inland. Ventana Wilderness and the Santa Lucia range are bordered on the west side by the Pacific Ocean and on the east side by Carmel Valley, Sierra de Salinas, and the Salinas Valley. Carmel Valley and Salinas Valley both exit into the Monterey Bay area to their northwest. The Santa Lucia range is thus within the maritime influence of the Pacific Ocean on the west and east side.

Figure 3. WINHAZE image of Ventana Wilderness Area (8.9 vs. 18.5 deciviews)

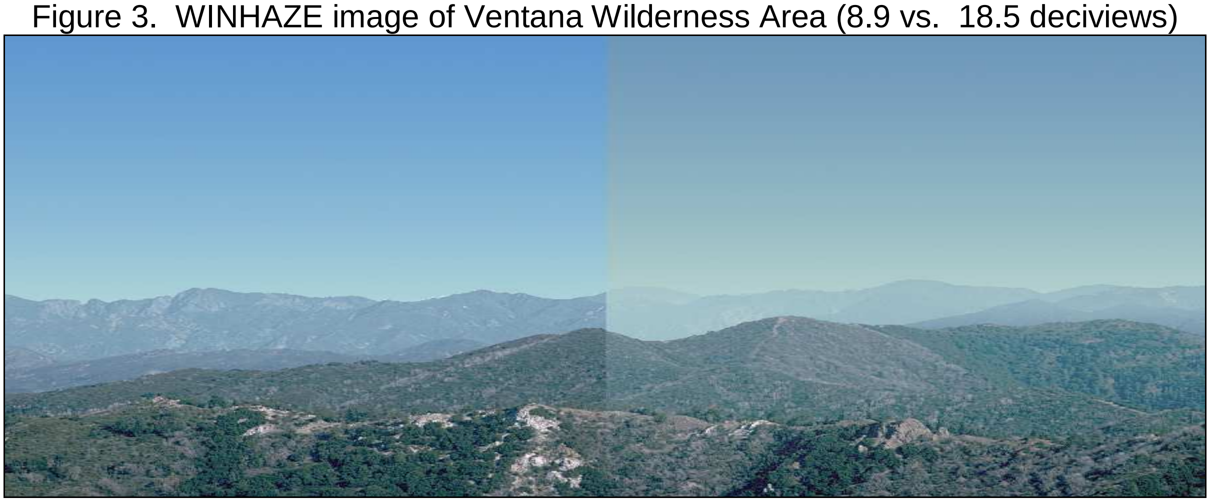
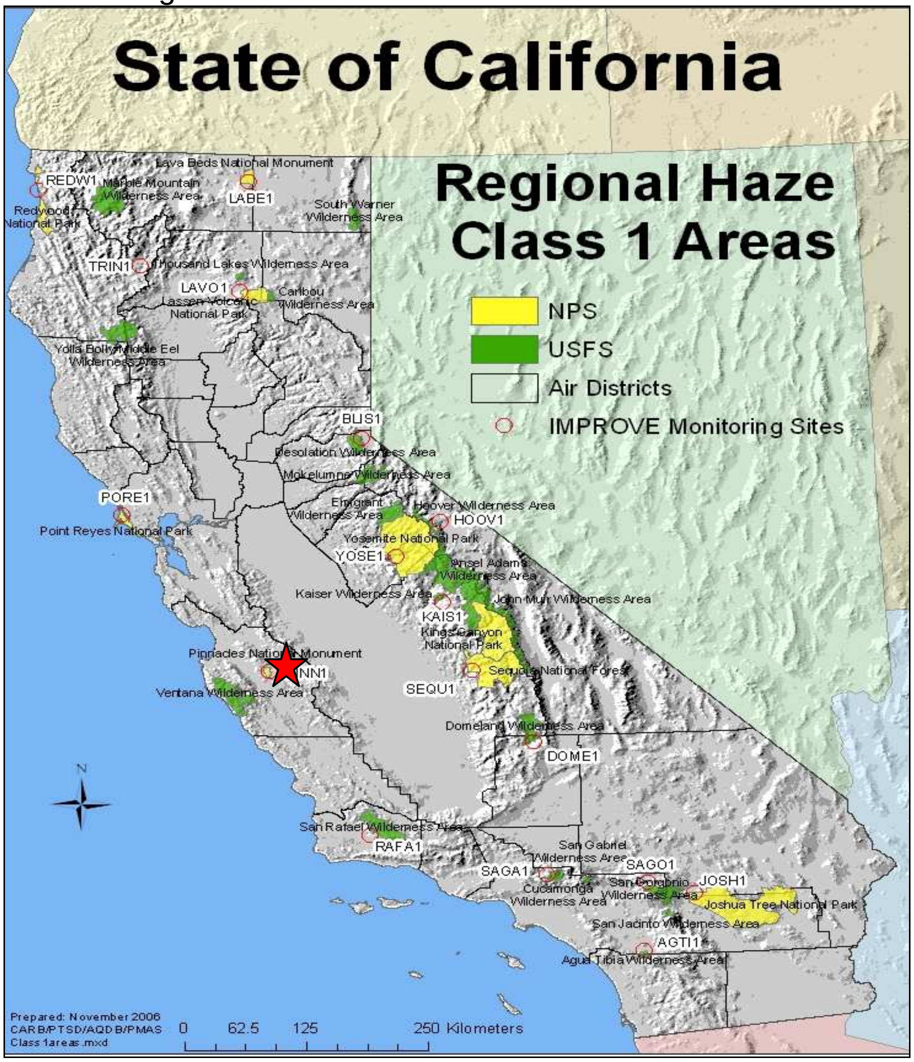


Figure 4. PINN1 Monitor location in California



Section II. Visibility Conditions:

II.a. Pinnacles National Monument

Visibility conditions for Pinnacles are currently monitored by the PINN1 IMPROVE monitor. The monitor is located at 36.4833 north latitude and 121.1568 west longitude in the Chalone Creek drainage near the eastern wilderness boundary at an elevation of 302 meters. This is very near the lower end of the Pinnacles Wilderness elevations and approximately 609 meters lower than the highest Wilderness elevation.

The PINN1 IMPROVE site is representative of Pinnacles locations in general, although it is in the Chalone Creek drainage at a relatively low elevation with respect to most of the Wilderness.

The monitor may be isolated from higher elevations if a summertime inversion exists, or by being within a low-level wintertime inversion. These are probably relatively infrequent conditions, given the modest range of Wilderness elevations that extend about 762 meters vertically. The Pinnacles Wilderness is potentially influenced by three California source regions: the San Francisco Bay area, the San Joaquin Valley, and the Monterey Bay area. Aerosol concentrations in Pinnacles may be most closely linked to Bay Area emissions during episodic conditions that lead to aerosol accumulations.

The PINN1 location is adequate for assessing the 2018 reasonable progress goals for the Pinnacles Wilderness Class 1 area.

II.b. Ventana Wilderness Area

Visibility conditions for Ventana are currently monitored by the PINN1 IMPROVE monitor on the eastern side of the Pinnacles Wilderness Area. The monitor is located at 36.4833 north latitude and 121.1568 west longitude, about 30 miles to the east of Ventana Wilderness, across the Salinas Valley, at an elevation of 302 meters.

PINN1 is likely much more influenced by the San Francisco Bay and San Joaquin Valley source regions, and less influenced by the Pacific Ocean. Its representation of the Ventana Wilderness may thus be marginal, and aerosol concentrations in the Ventana Wilderness are probably much less than indicated by measurements at PINN1. The nearest population center to the Ventana Wilderness Area is the Monterey Bay area. There may also be some impact from the Bay Area with transport southward via interior Santa Clara and Santa Bonita valleys, although emissions from those areas are likely pushed further east towards the Galiban Range and Pinnacles Wilderness area.

The PINN1 location is adequate for assessing the 2018 reasonable progress goals for the Ventana Wilderness Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from PINN1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the PINN1 monitor is calculated at 8.9 deciviews for the 20% best days and 18.5 deciviews for the 20% worst days. Figure 5 represents the worst baseline visibility conditions.

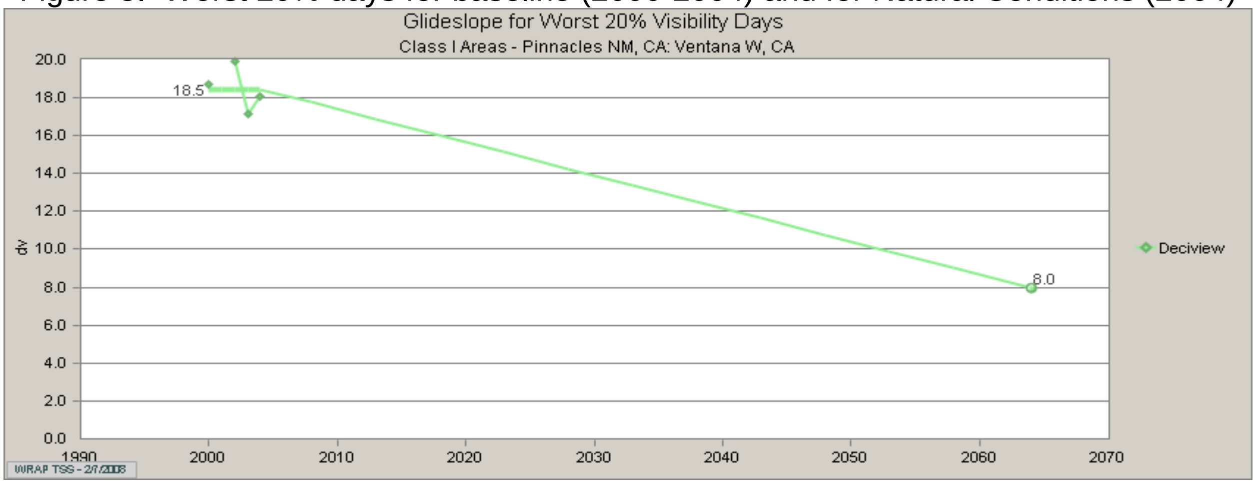
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the PINN1 monitor is 3.5 deciviews for the 20% best days and 8.0 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 5 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 16.02 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 8.9 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 5. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 6 shows the contribution of each species to the 20% best and worst days in the baseline years at PINN1.

Figure 6. Average Haze species contributions to light extinction in the baseline years

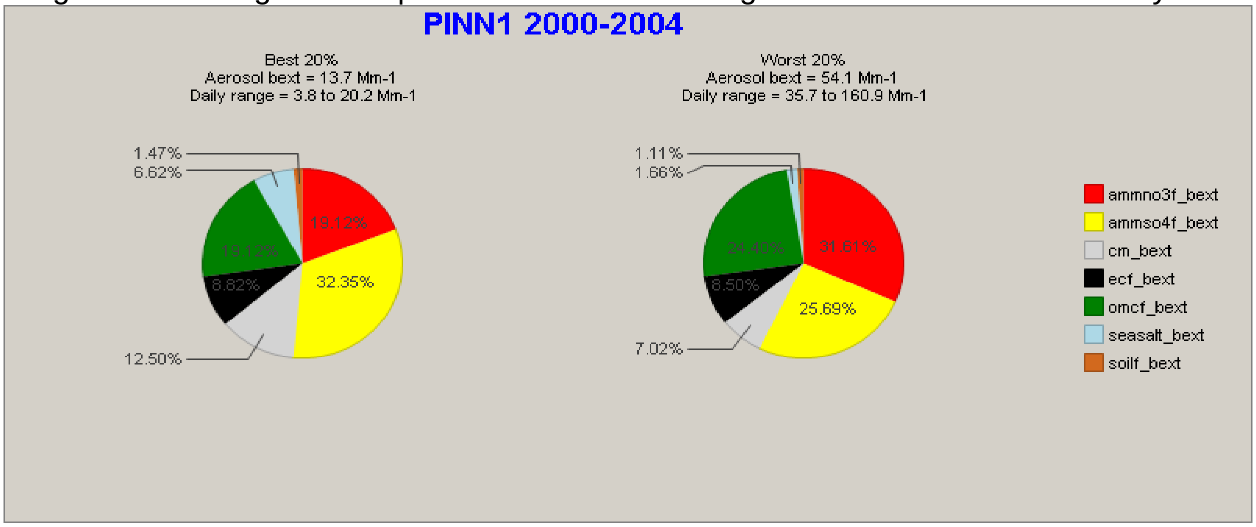
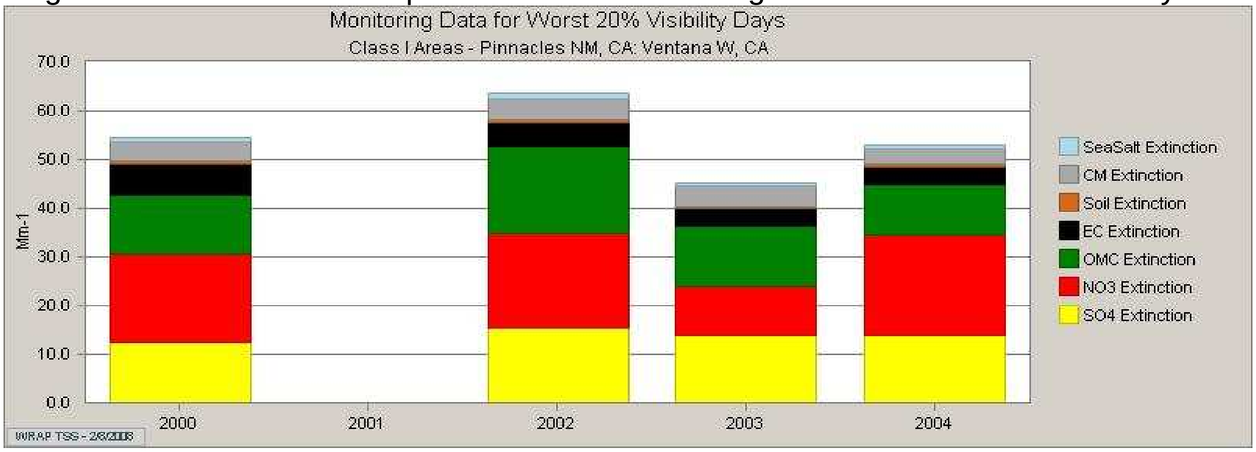


Figure 7. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 6 and 7, nitrates, sulfates, and organic matter have the strongest contributions to degrading visibility on worst days at the PINN1 monitor. The worst days are dominated by nitrate, while the best days are dominated by sulfate. Data points for 2001 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 8 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter time while sulfates increase slightly in the spring and summer time. The occurrence of elevated organic matter concentrations is sporadic throughout the year. Nitrates clearly dominate the other haze species on worst days, but sulfates, organic matter, coarse mass, elemental carbon, and sea salt also contribute to the worst days. There are only trace amounts of sea salt and soil present throughout the years.

Figure 9 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 8 for nitrates, sulfates, and organic matter. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 8. Species contribution on the 20% worst days in 2002

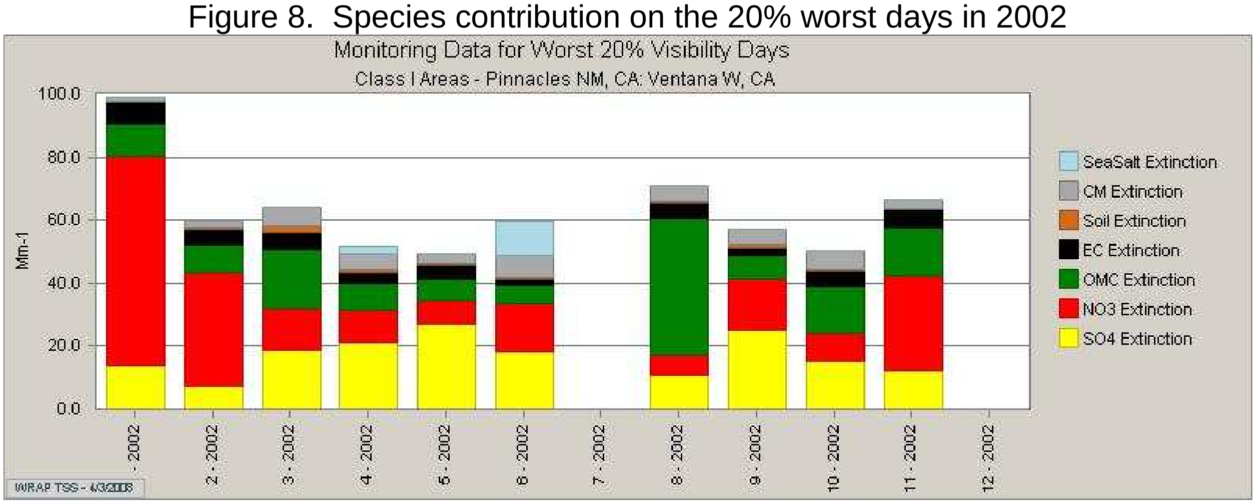
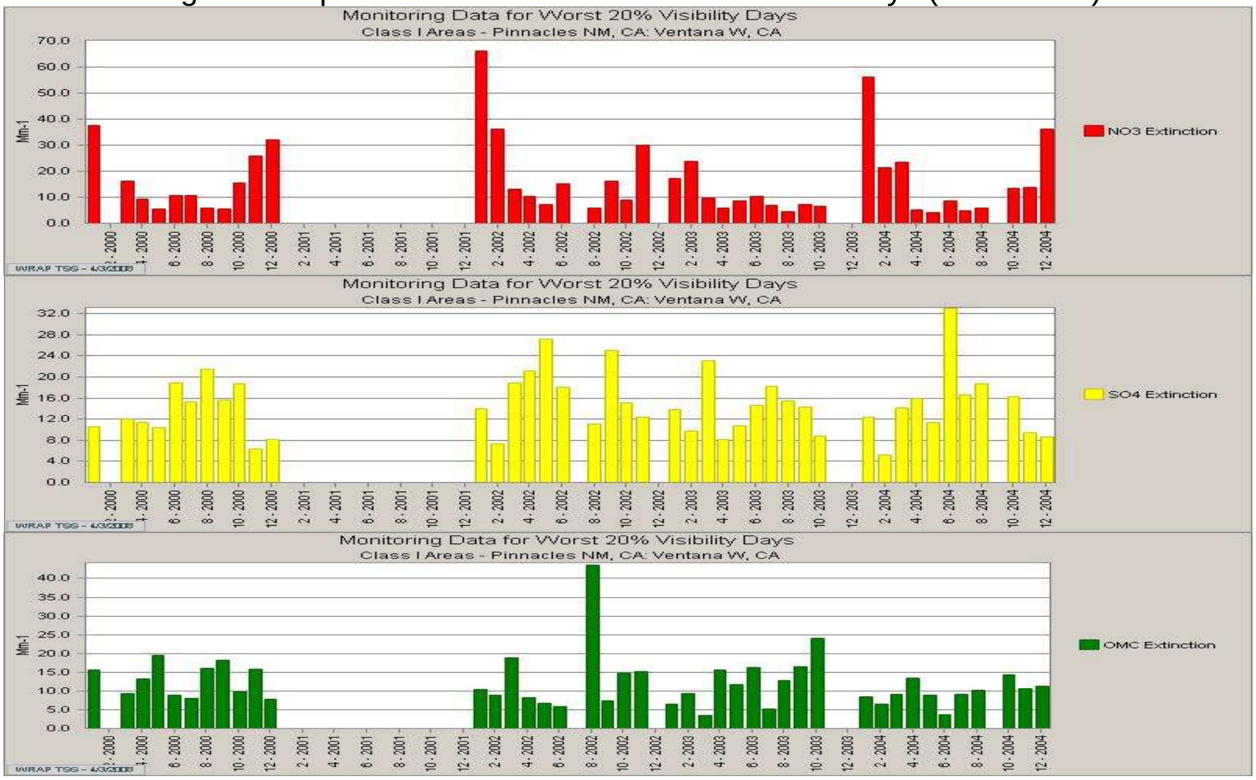


Figure 9. Species contribution on the 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at PINN1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 10 and 11 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (85%), followed by the Pacific Offshore Region (9%) and emissions from Outside Domain (5%). Mobile sources within California contribute the most nitrate at the PINN1 monitor. In 2002, 90% of the nitrate from mobile sources at the PINN1 monitor can be attributed to California. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figures 12 and 13 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at PINN1. The WRAP region represents 36% of the sulfate contributions in 2002 and 2018, followed by the emissions from the Outside Domain Region (35%) and the Pacific Offshore Region (27%). California contributes 26% of the total sulfate emissions seen at the PINN1 monitor.

Individually, emissions from outside the modeling domain contribute the most sulfate concentrations at the PINN1 monitor. The next largest contributor to sulfate concentration is area sources in the Pacific Offshore Region.

Figure 14 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the PINN1 monitor is from area sources within California. California represents 96% of all area source contributions.

Figure 15 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 63% of the total organic carbon. Biogenic secondary emissions account for 31% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figure 10. Regional Nitrate contribution to Haze in 2002 and 2018

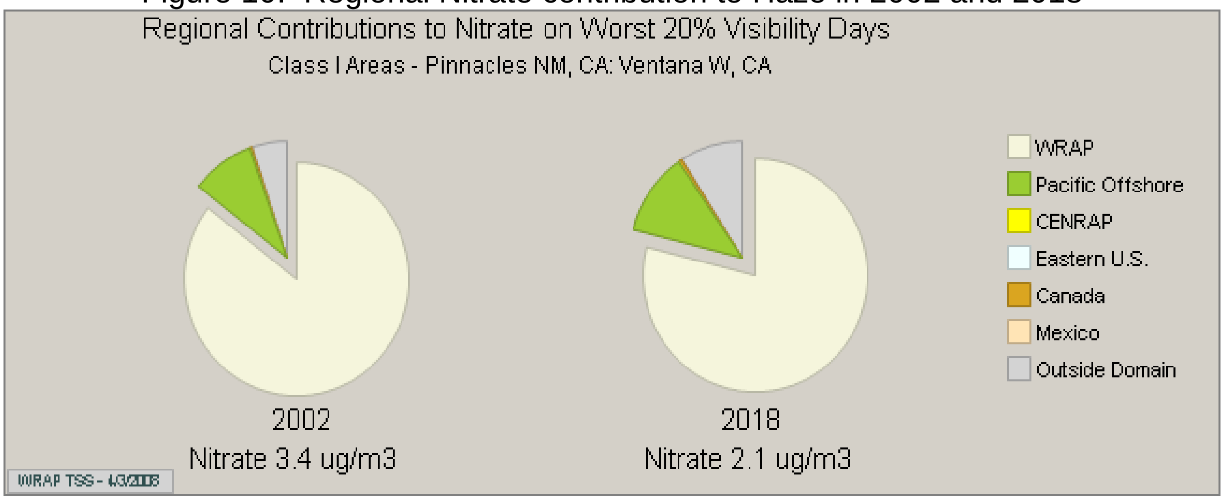


Figure 11. Nitrate source contribution from CA and outside regions

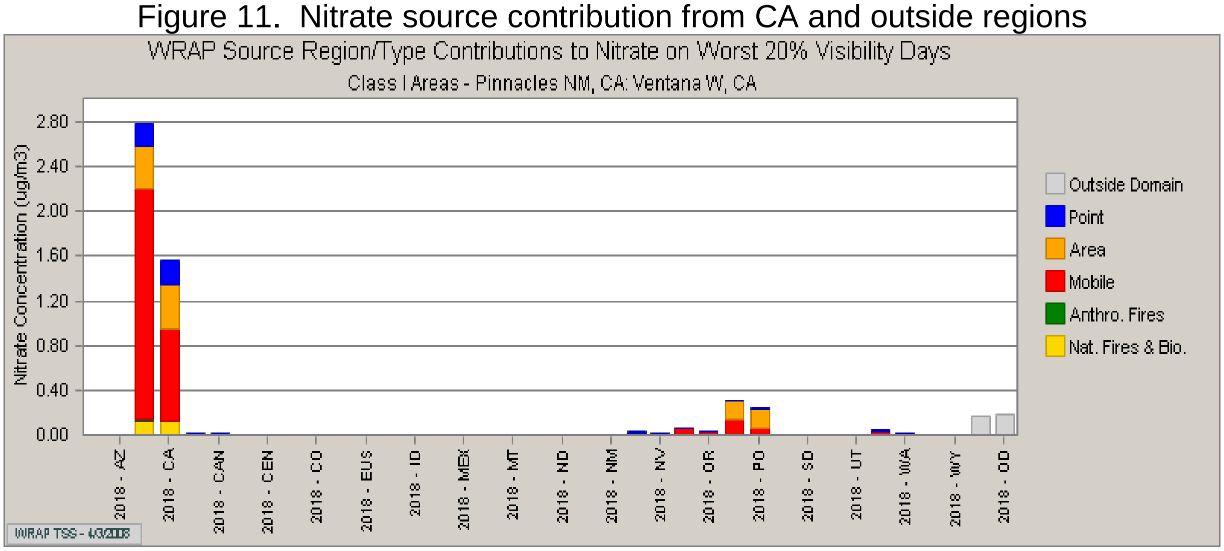


Figure 12. Regional Sulfate contribution to Haze in 2002 and 2018

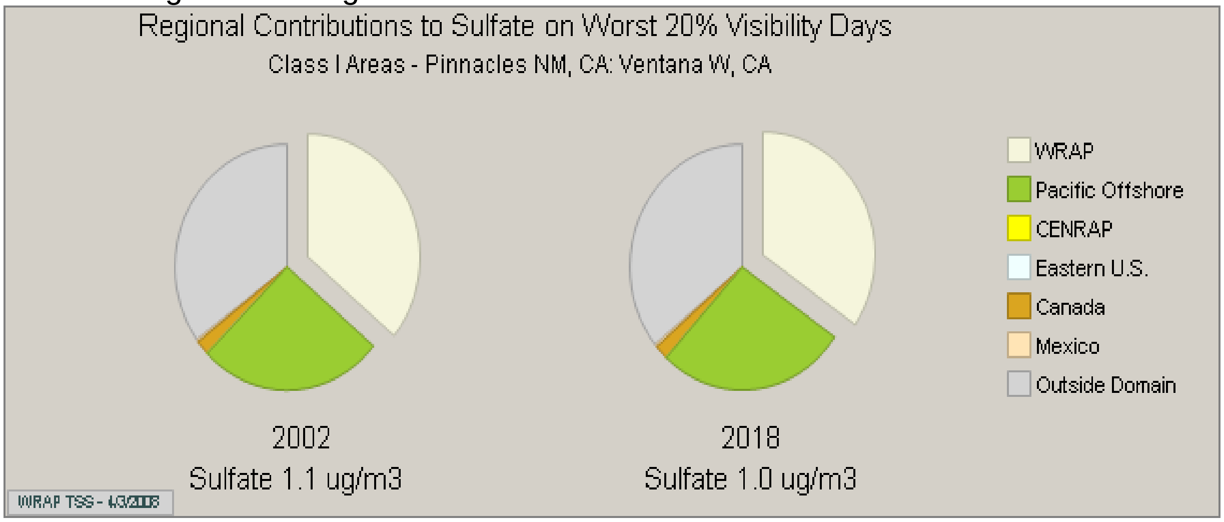


Figure 13. Sulfate source contribution from CA and outside regions

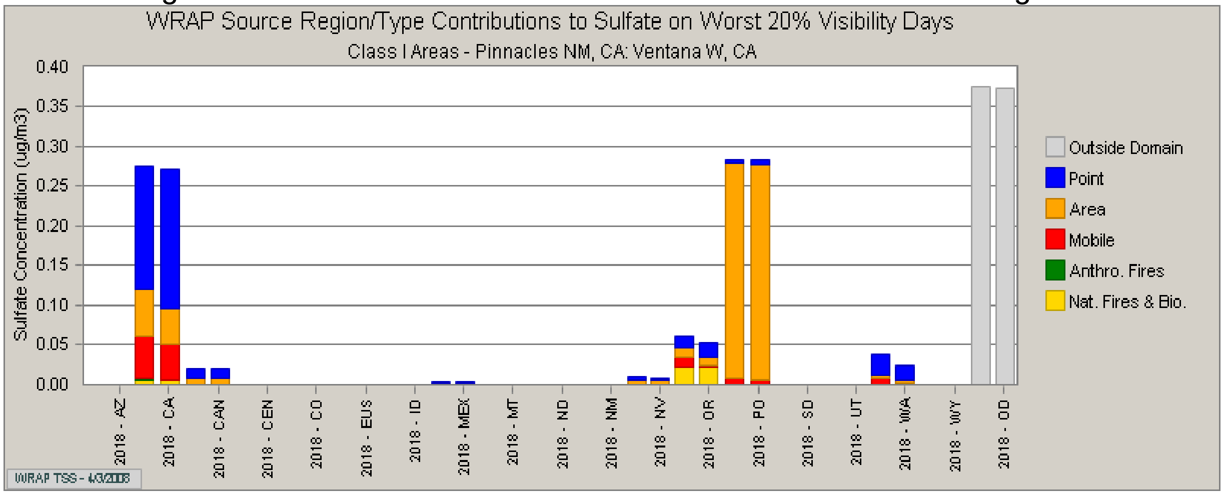


Figure 14. Organic carbon source contribution from CA and outside regions

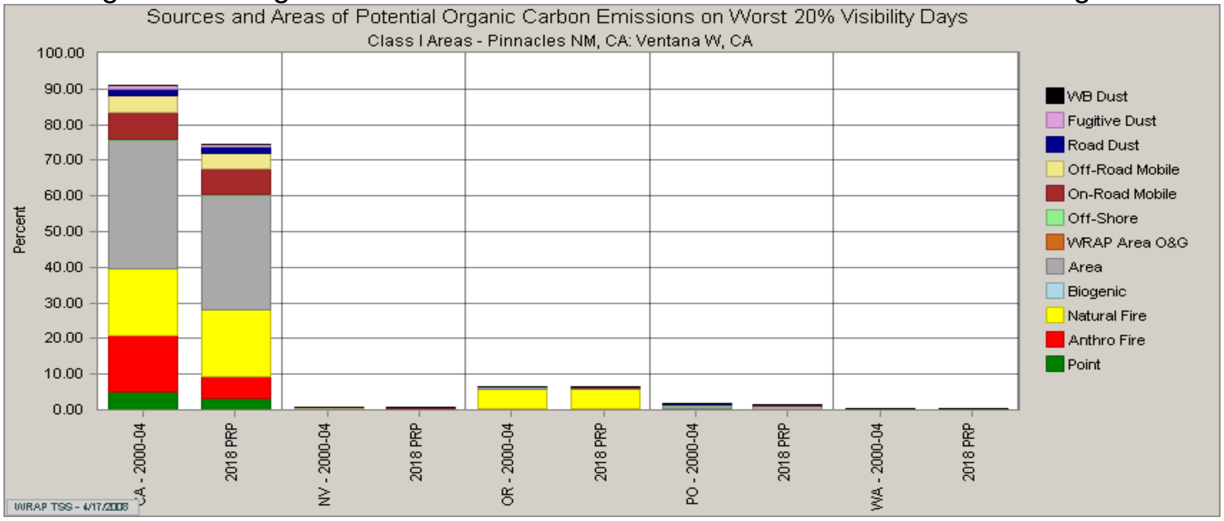
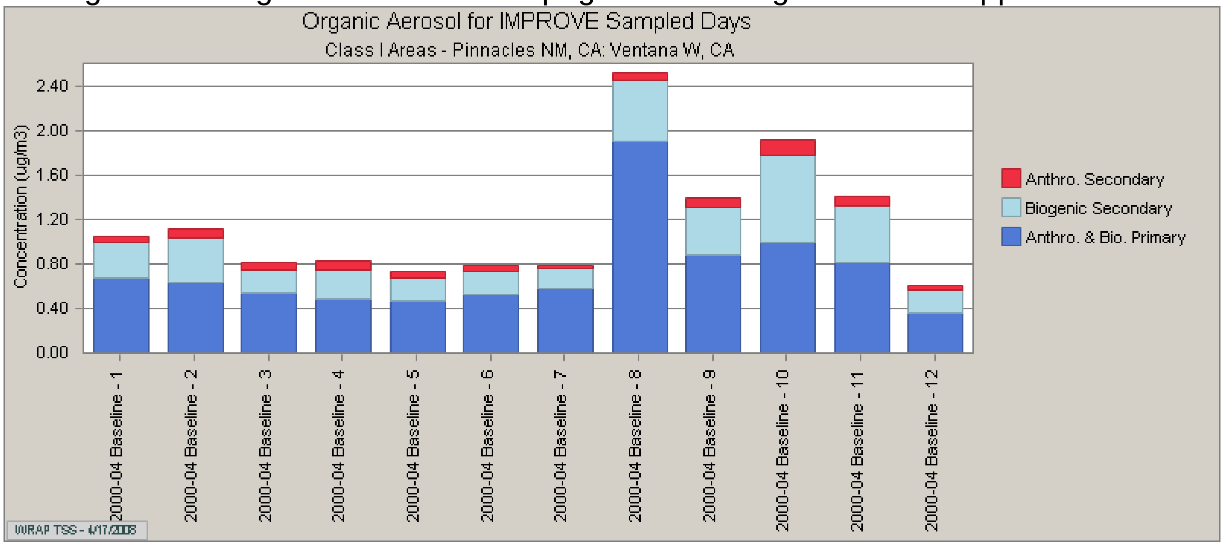


Figure 15. Organic carbon Anthropogenic and Biogenic source apportionment



RAFA1 Monitor

Section I. Description

The San Rafael Wilderness Area (San Rafael) consists of 200,000 acres in the San Rafael and Sierra Madre Mountain Ranges in southern California. It is near the southernmost extent of the Coast Ranges that separate the coast from the Central Valley and deserts of interior California. These east-west ranges form part of the barrier between the southernmost extent of the central valley and the Santa Barbara Coast 20 miles to the south of the southeastern Wilderness boundary. The Sisquoc River flows west towards the Pacific Ocean through the heart of the San Rafael Wilderness from its headwaters near the eastern boundary, between the Sierra Madre range on the north and the San Rafael range on the south. Elevations range from 355 meters near the confluence of the Sisquoc River with Manzana Creek in the west to over 2,073 meters on Big Pine Mountain near the eastern boundary.

Figure 1. RAFA1 Monitor location

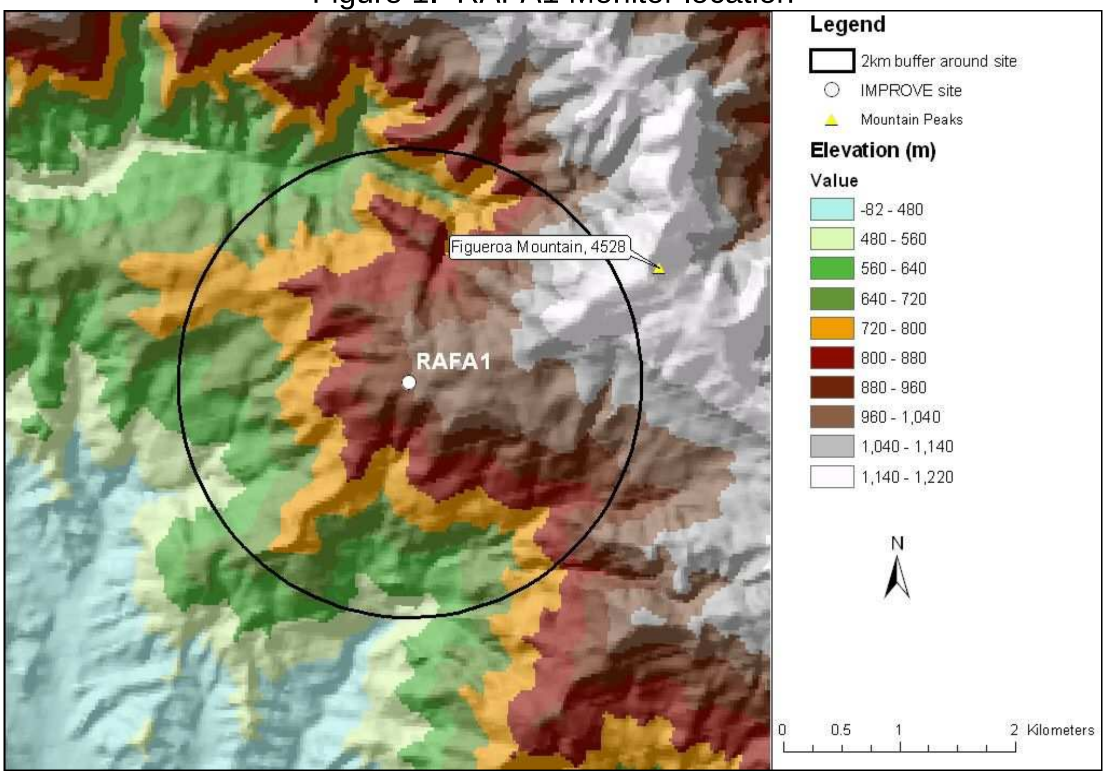


Figure 2. RAFA1 Monitor location in California

Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for San Rafael are currently monitored by the RAFA1 IMPROVE monitor. The monitor is located at 34.7339 north latitude and 120.0074 west longitude, near the crest of a low ridge outside of the southern wilderness boundary at an elevation of 957 meters. The site has been operating since February 2000. This site has sufficient data for the entire baseline period.

The RAFA1 IMPROVE site should be quite representative of Wilderness conditions in general. It is on a well-exposed ridge location near the southern boundary at an elevation near the midrange of Wilderness elevations. It may be less representative of lower Wilderness elevations along the Sisquoc River valley if a lower level valley inversion exists. The lower Sisquoc River is also subject to occasional onshore flow from the Pacific Ocean, which can bring high humidity and fog, although this may be a relatively infrequent occurrence. The San Rafael Wilderness is centrally located with respect to three areas with potential to impact visibility: the southern Central Valley, coastal areas of Santa Barbara County, and the Los Angeles basin. The southern Central Valley has potential for impacting visibility during Santa Ana conditions, while emissions from the Los Angeles basin may be channeled into the Wilderness via a coastal river valley near Ojai or transported aloft during easterly upper airflow during the winter.

The RAFA1 location is adequate for assessing the 2018 reasonable progress goals for the San Rafael Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from RAFA1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the San Rafael Wilderness Area is calculated at 6.4 deciviews for the 20% best days and 18.8 deciviews for the 20% worst days. Figure 3 represents the worst baseline visibility conditions.

II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the San Rafael Wilderness is 1.8 deciviews for the 20% best days and 7.6 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 3 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 16.20 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 6.4 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 3. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)

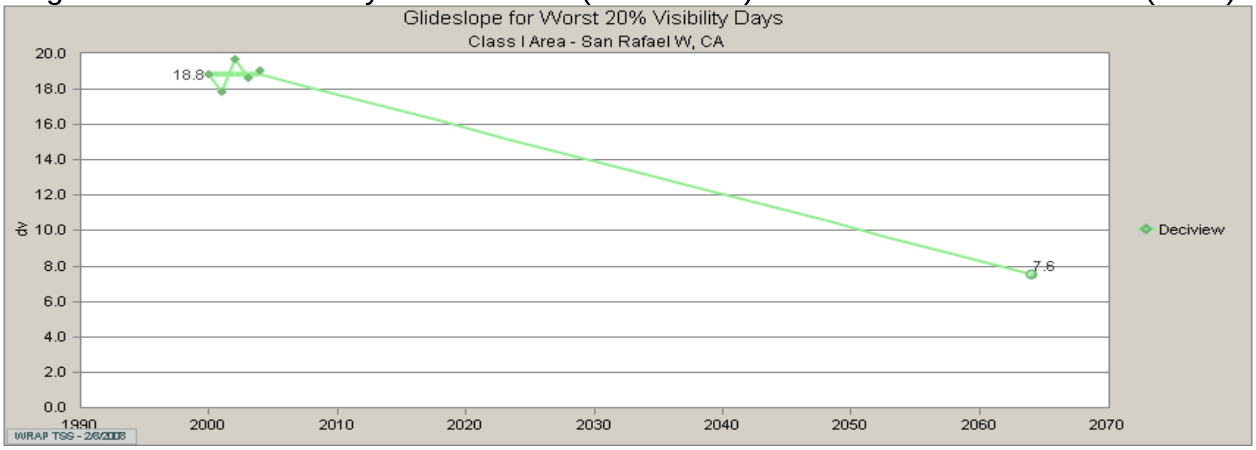
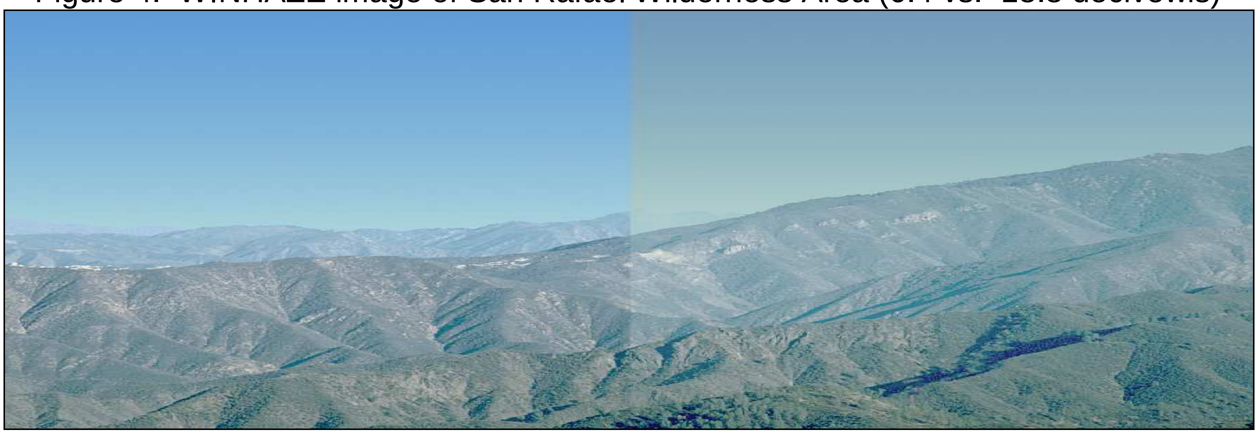


Figure 4. WINHAZE image of San Rafael Wilderness Area (6.4 vs. 18.8 decivewis)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at RAFA1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

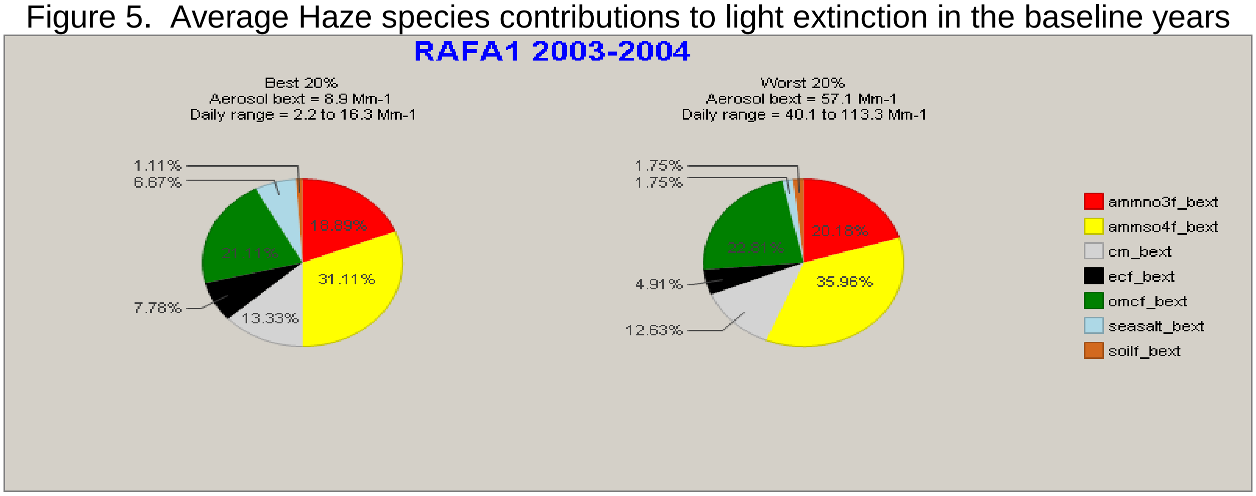
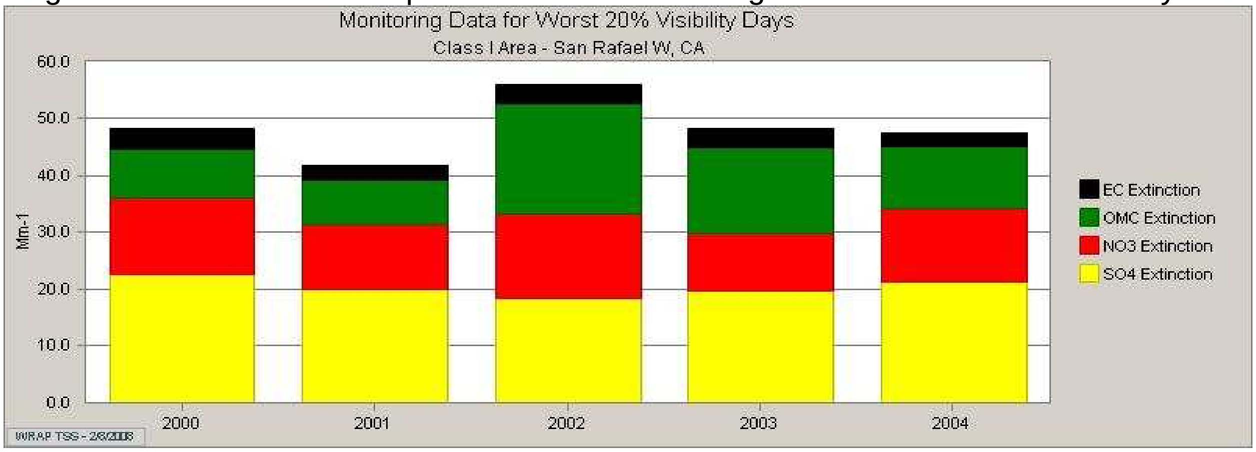


Figure 6. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, sulfates, organic matter, and nitrates have the strongest contributions to degrading visibility on worst days at San Rafael Wilderness Area. Sulfates dominate on both the worst and best days.

Figure 7 depicts the individual species contribution to worst days in 2002. Sulfates are seen to increase in the summer while nitrates increase in the winter months. The occurrence of elevated organic matter concentrations is sporadic throughout the year. Sulfates clearly dominate the other haze species on worst days, but organic matter, nitrates, coarse mass and elemental carbon also contribute to the worst days. There are only trace amounts of sea salt and soil present throughout the years.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for sulfates, organic matter, and nitrates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2002

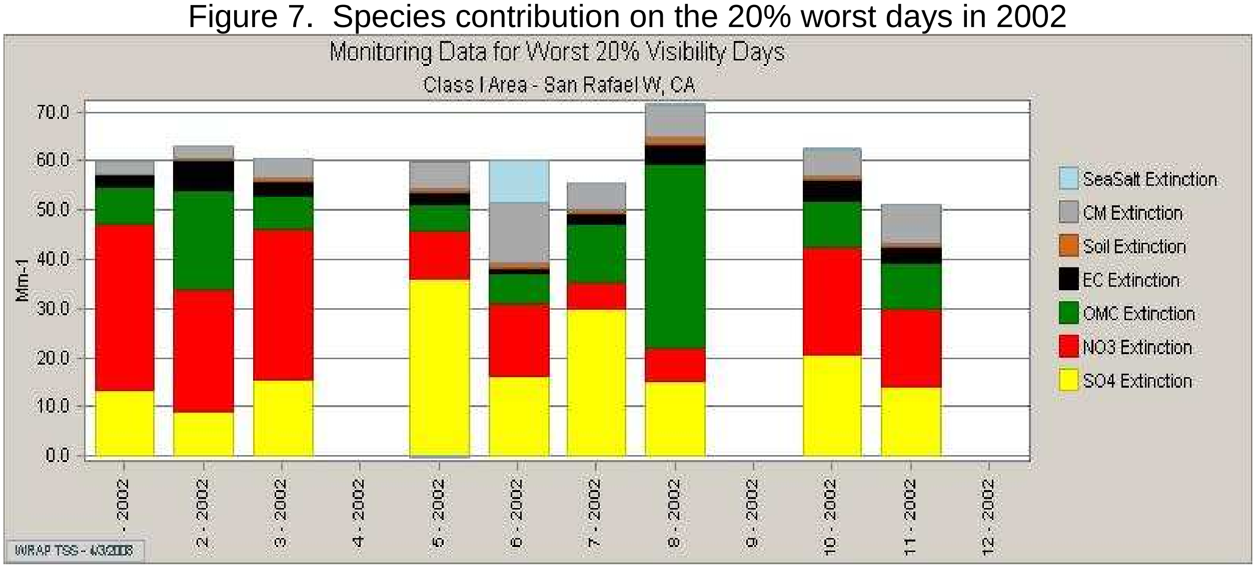
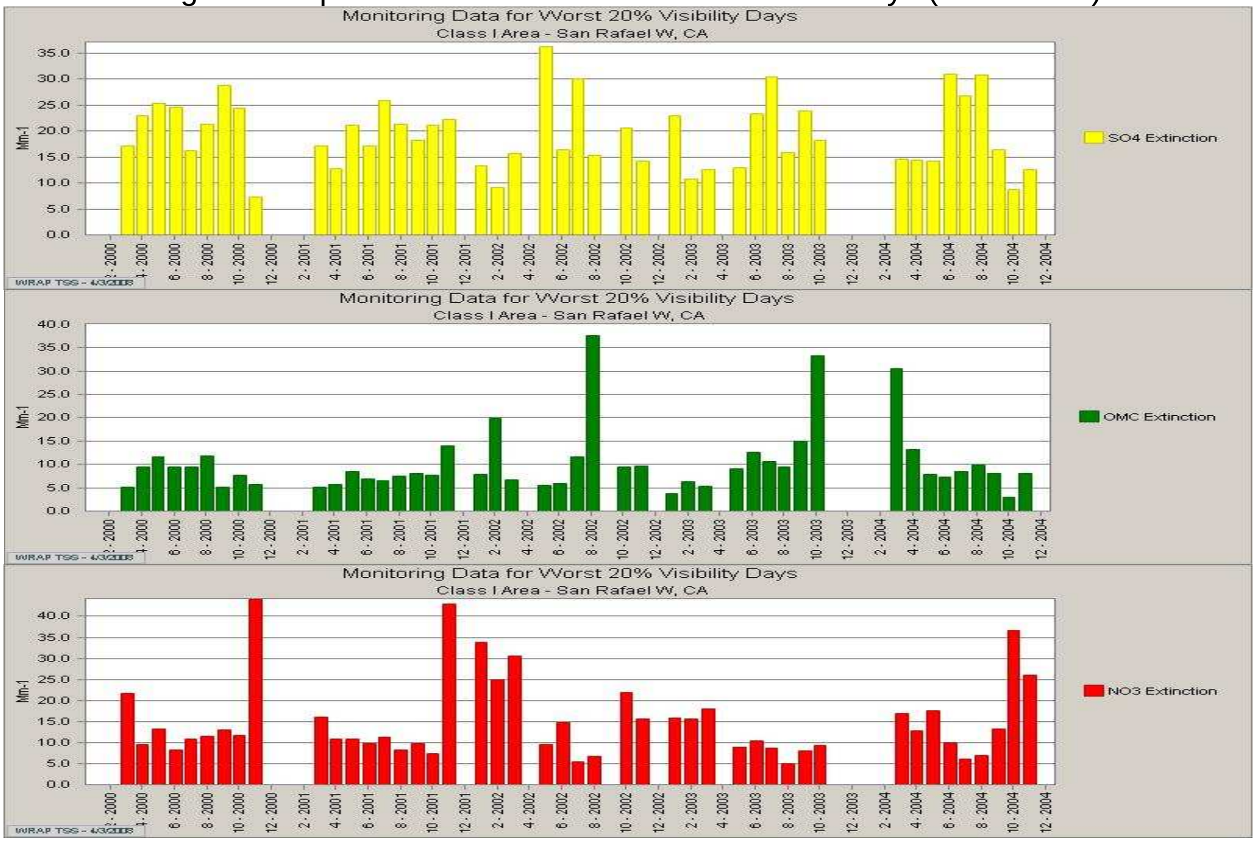


Figure 8. Species contribution on the 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at RAFA1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether or not they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and (anthropogenic) emissions transported from outside the United States.

Figures 9 and 10 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at RAFA1. The Pacific Offshore region represents 34% of the sulfate contributions in 2002 and 2018, followed by the emissions from the WRAP Region (32%) and the Outside Domain Region (30%). California contributes 20% of the total sulfate emissions seen at the RAFA1 monitor.

Individually, emissions from area sources in the Pacific Offshore contribute the most to sulfate concentrations at the RAFA1 monitor. The next largest contributor to sulfate concentrations is from outside the modeling domain.

Figure 11 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the RAFA1 monitor is from natural fire sources within California. California represents 95% of all natural fire source contributions.

Figure 12 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 60% of the total organic carbon. Biogenic secondary emissions account for 33% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 13 and 14 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (82%), followed by the Pacific Offshore Region (10%) and emissions from Outside Domain (7%). Mobile sources within California contribute the most nitrate at the RAFA1 monitor. In 2002, 90% of the nitrate from mobile sources at the RAFA1 monitor can be attributed to California. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 9. Regional Sulfate contribution to haze in 2002 and 2018

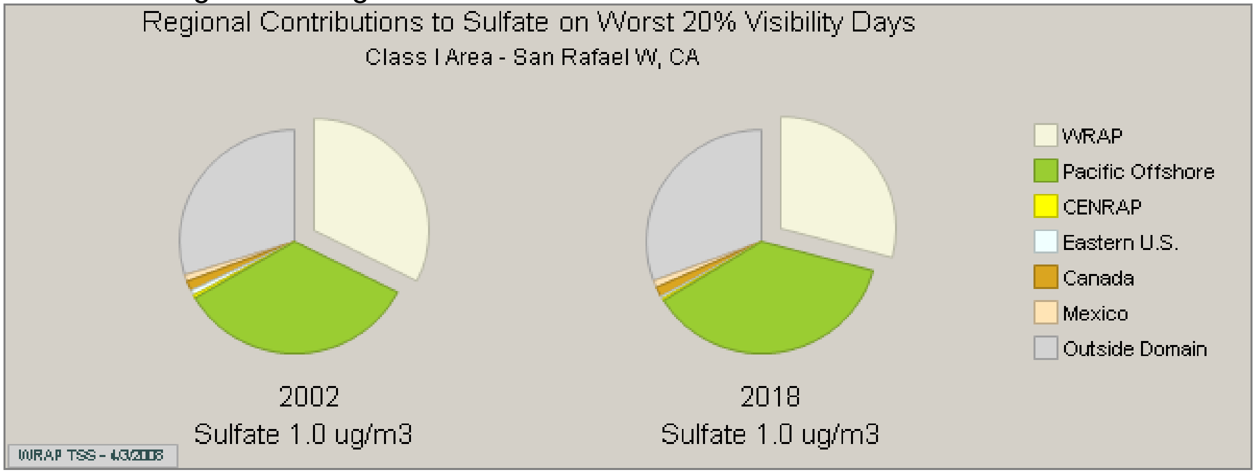


Figure 10. Sulfate source contribution from CA and outside regions

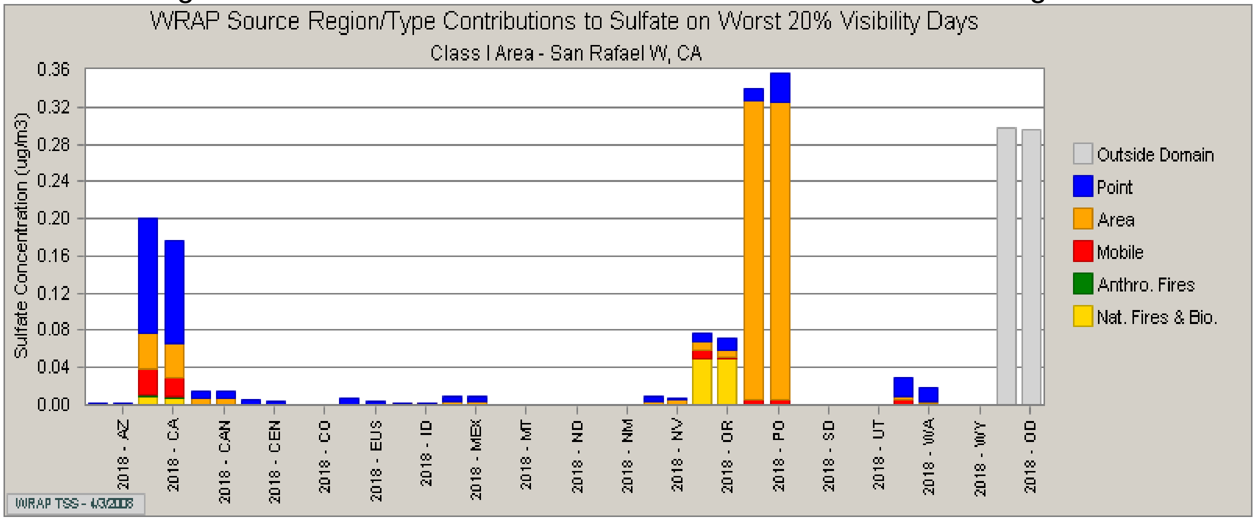


Figure 11. Organic carbon source contribution from CA and outside regions

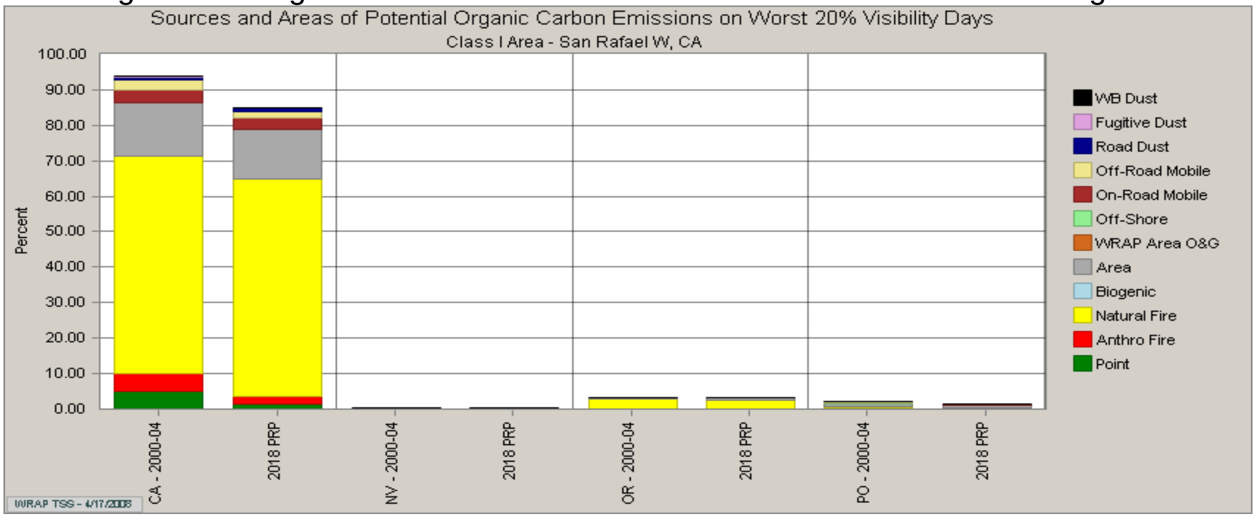


Figure 12. Organic carbon Anthropogenic and Biogenic Source apportionment

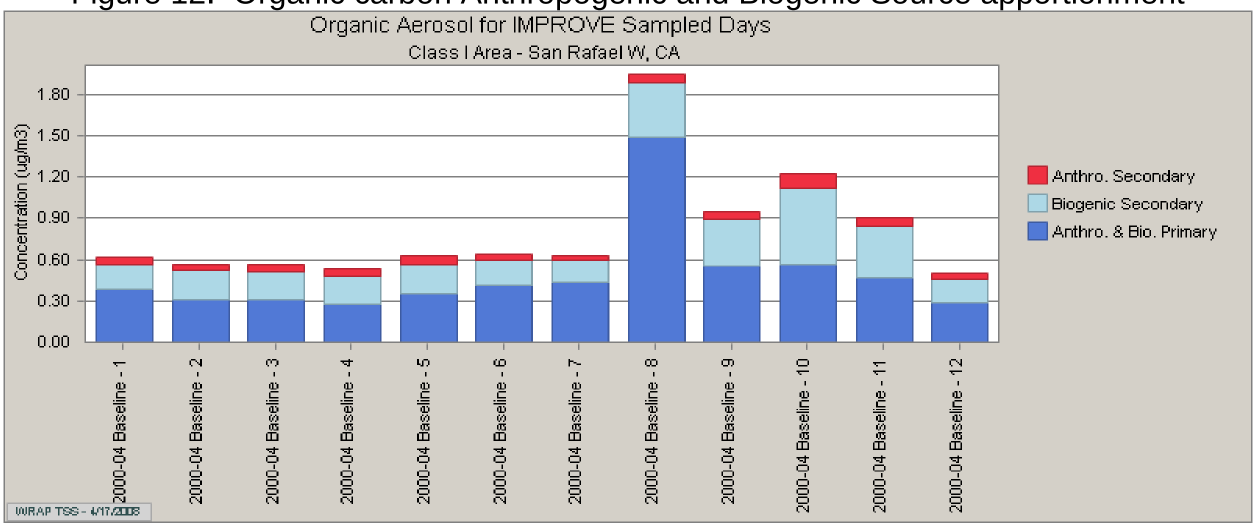


Figure 13. Regional Nitrate contribution to haze in 2002 and 2018

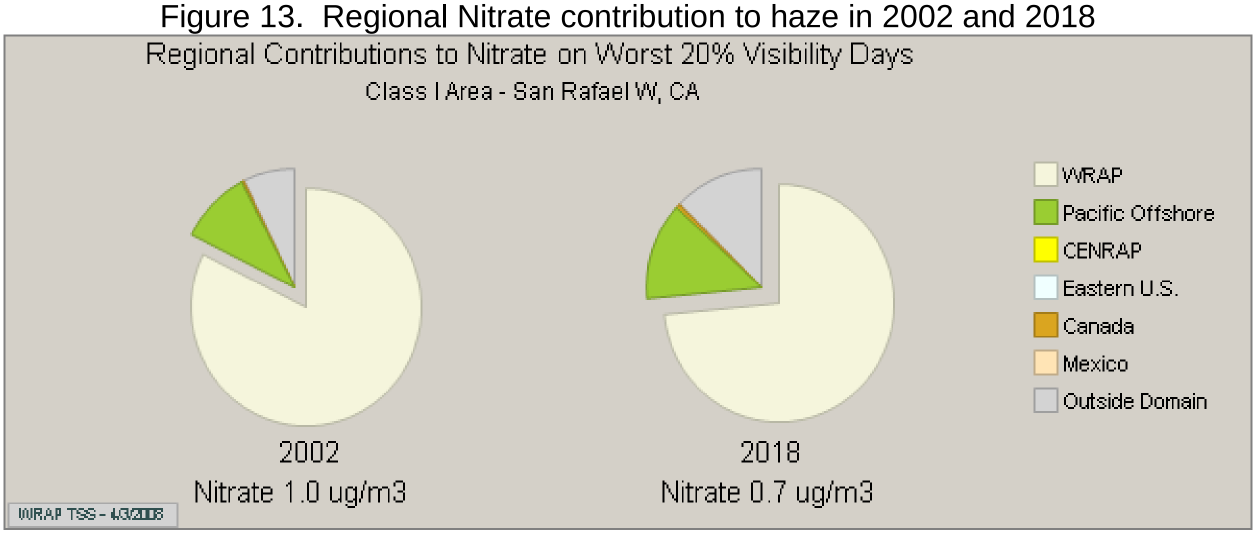
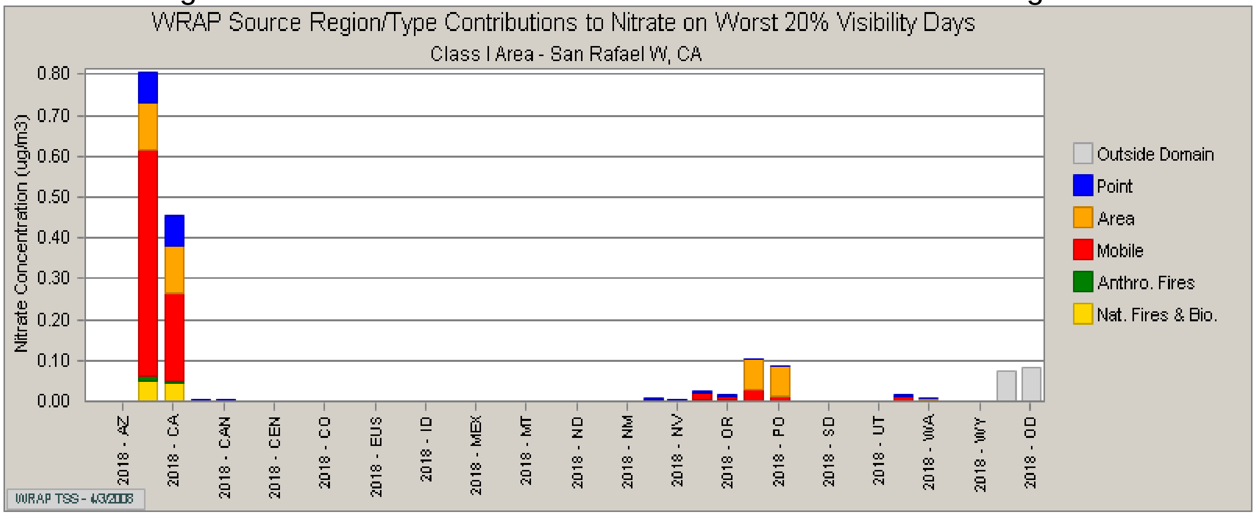


Figure 14. Nitrate source contribution from CA and outside regions



SAGA1 Monitor

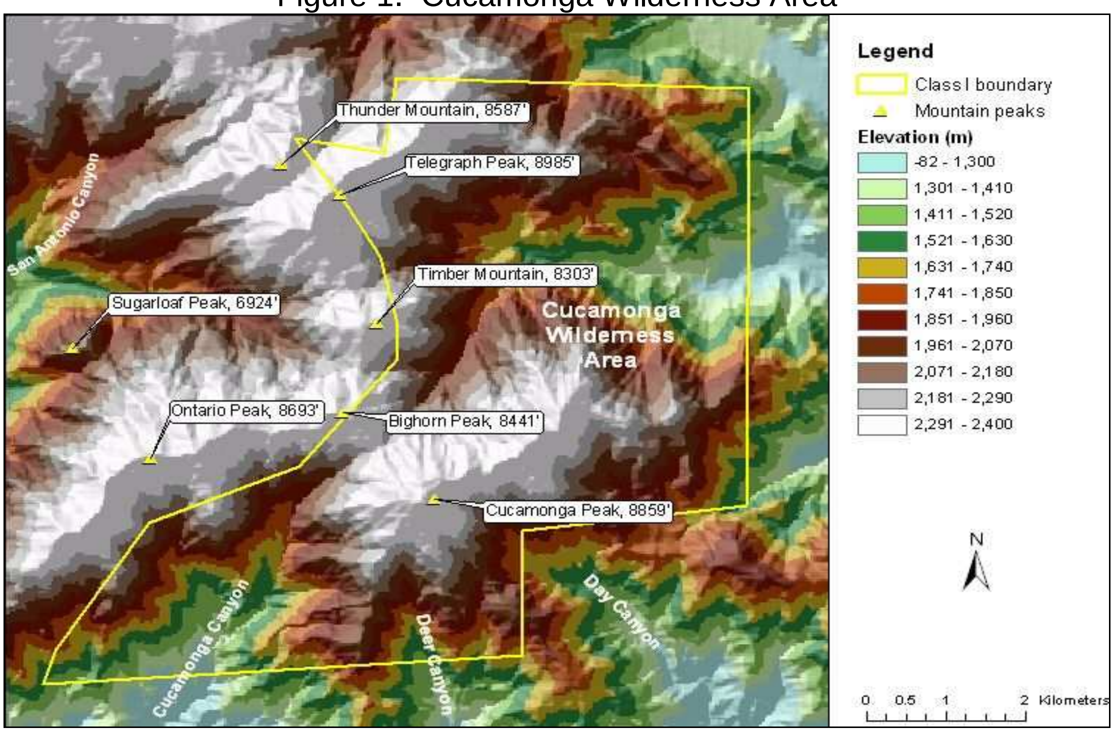
The SAGA1 monitor location represents two wilderness areas located in the San Gabriel Mountains. The wilderness areas associated with the SAGA1 monitor are Cucamonga Wilderness Area and San Gabriel Wilderness area. The SAGA1 site has been operating since December 2000. This site does not have sufficient data for the entire baseline period. Data was not available for the years 2000 and 2001.

<u>Section I. SAGA1 Wilderness Area Descriptions</u>

I.a. Cucamonga Wilderness Area

The Cucamonga Wilderness Area (Cucamonga) occupies 12,981 acres on the western end of the San Gabriel Mountains, one of the Transverse Ranges that lie along an east-west axis from the Santa Barbara coast to the Mojave Desert creating a natural barrier between central and southern California. Wilderness elevations range from about 1310 meters to 2500 meters, with highest elevations at the crests of Telegraph Peak (2738 meters) and Cucamonga Peak (2700 meters). Cucamonga and Deer Canyons drop south from Cucamonga Peak to the southern Wilderness boundary, then south 4 to 6 miles into the Los Angeles basin near the cities of Pomona, Ontario, and Rancho Cucamonga, forming the most direct route for low elevation urban pollution transport into the Wilderness.

Figure 1. Cucamonga Wilderness Area



I.b. San Gabriel Wilderness Area

The San Gabriel Wilderness Area (San Gabriel) occupies 34,118 acres on the southern slopes of the San Gabriel Mountains, one of the Transverse Ranges that lie along an east-west axis from the Santa Barbara coast to the Mojave Desert. Elevations range from 488 meters to 2500 meters. Highest elevations are along the ridge of the San Gabriel Mountains that forms the northern San Gabriel boundary. Lowest elevations are along the West Fork of the San Gabriel River that flows eastward in this area and forms the southern San Gabriel boundary. From the southeast corner of the Wilderness the San Gabriel River flows southward about 6 miles into the Los Angeles Basin between Pasadena and Pomona. This stretch of the San Gabriel Canyon includes San Gabriel and Morris Reservoirs. The San Gabriel River Valley thus forms the most direct conduit for low elevation urban pollution transport into the Wilderness.

Figure 2. SAGA1 Monitor location

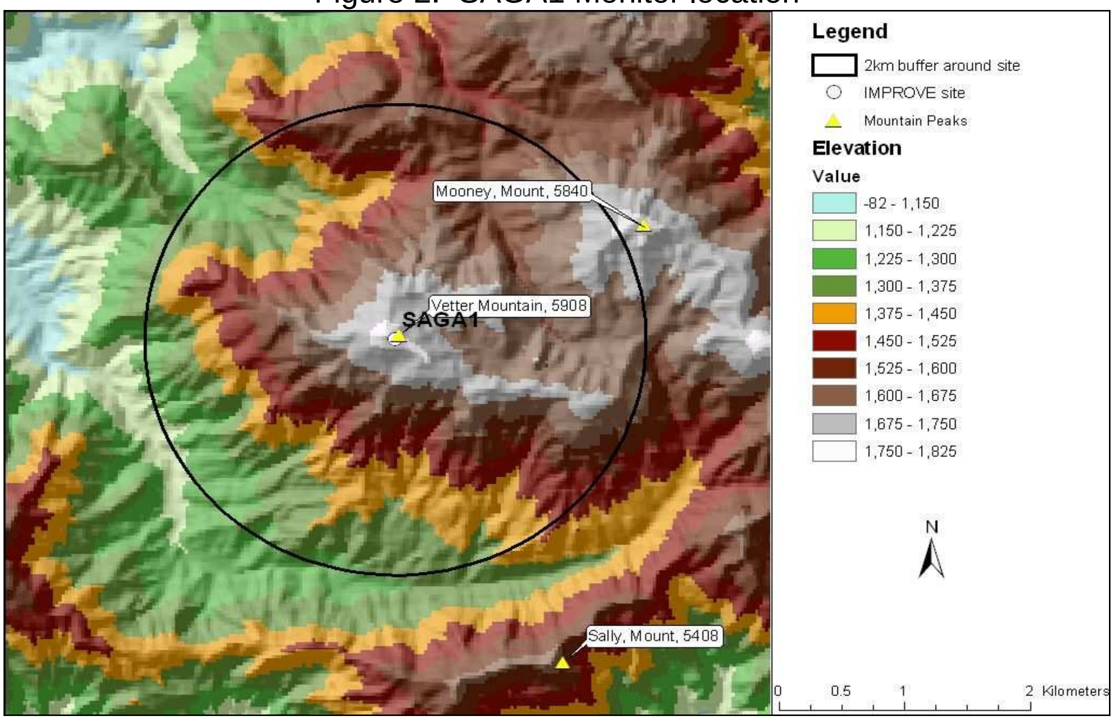
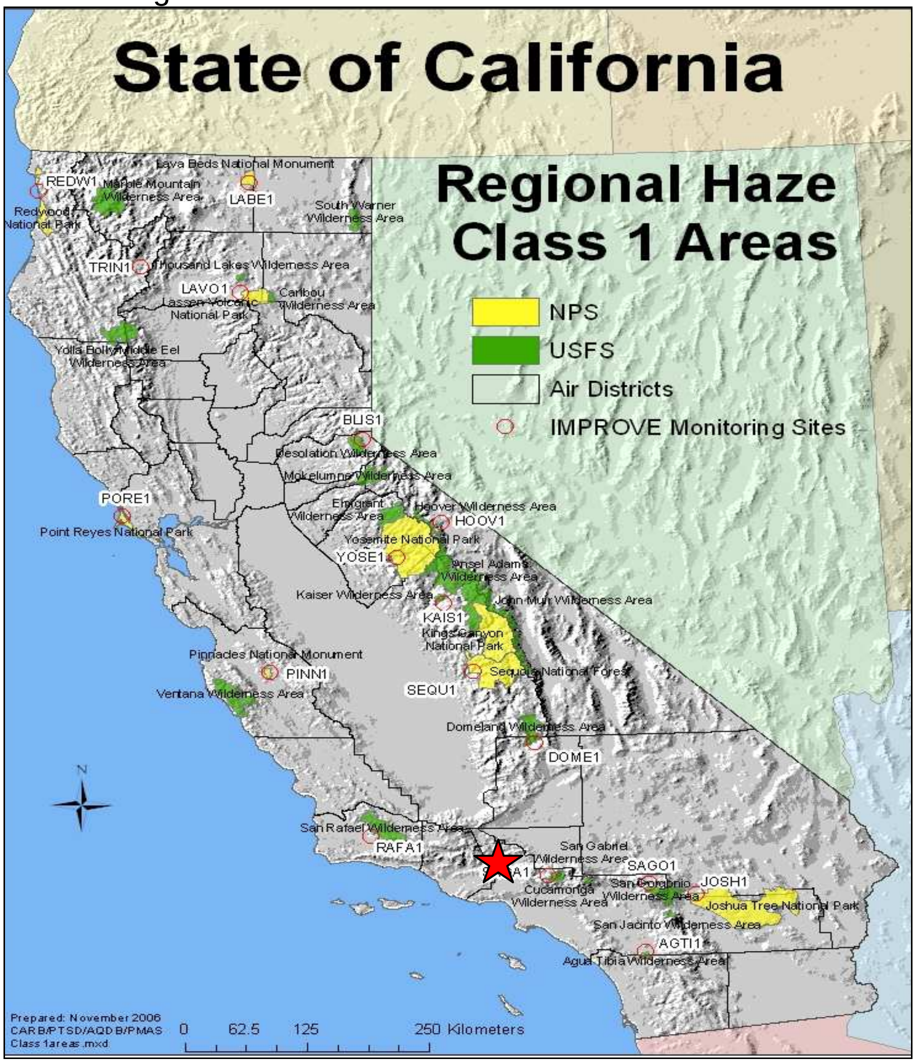


Figure 3. SAGA1 Monitor location in California



Section II. Visibility Conditions:

II.a. Cucamonga Wilderness Area

Visibility conditions for Cucamonga Wilderness are currently monitored by the SAGA1 IMPROVE monitor located just outside the western boundary of the San Gabriel Wilderness. The monitoring site is located at 34.2969 north latitude and 118.0282 west longitude, about 20 miles west of the Cucamonga Wilderness, with mountainous intervening terrain. It is a well-exposed ridge-top site at an elevation of 1791 meters, near the lower end of the range of elevations within the Cucamonga Wilderness.

The SAGA1 monitoring site is separated from the Cucamonga Wilderness by about 20 miles of intervening complex mountainous terrain. It should be representative of aerosol composition and concentration at Cucamonga locations when the atmosphere is well mixed and haze is uniform over the region. It should also be representative of the impact of Los Angeles basin emission on the San Gabriel Mountains in general.

Lowest Wilderness elevations are probably above the regional marine layer that frequently overlies the Los Angeles basin and that typically thickens and advances inland during the night and early morning hours, before burning off around midday. It will be less representative of Cucamonga locations when impacted by local sources.

The SAGAI location is adequate for assessing the 2018 reasonable progress goals for the Cucamonga Wilderness Class 1 area.

II.b. San Gabriel Wilderness Area

Visibility conditions for San Gabriel are currently monitored by the SAGA1 IMPROVE monitor. The monitor is located at 34.2969 north latitude 36.49 and 118.0282 west longitude, just outside the western San Gabriel boundary. The monitor is in a well-exposed ridge-top site at an elevation of 1,791 meters, which is in the middle of the range of San Gabriel elevations.

The SAGA1 IMPROVE site should be well representative of aerosol composition and concentration at San Gabriel Wilderness locations, especially higher locations. It should also be representative of the impact of Los Angeles basin emissions within the San Gabriel Mountains generally. There may be times when lower Wilderness elevations, especially within Devils Canyon in the western Wilderness and the Bear Creek drainage in the eastern Wilderness, are contained within the regional marine layer that covers the Los Angeles basin much of the year, especially from late spring to early fall. The Los Angeles basin marine layer typically extends vertically to 305-610 meters. Elevations in these canyon and valley bottoms are about 600 meters, or about 914 meters lower than the SAGA1 IMPROVE site. The San Gabriel Wilderness is within 6 miles of the sprawling and heavily populated and industrialized South Coast Air Basin and is subject to its influence. The nearest Los Angeles area communities are Pasadena, El Monte, and Pomona.

The SAGA1 location is adequate for assessing the 2018 reasonable progress goals for the San Gabriel Wilderness Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from SAGA1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the SAGA1 monitor is calculated at 4.8 deciviews for the 20% best days and 19.9 deciviews for the 20% worst days. Figure 4 represents the worst baseline visibility conditions.

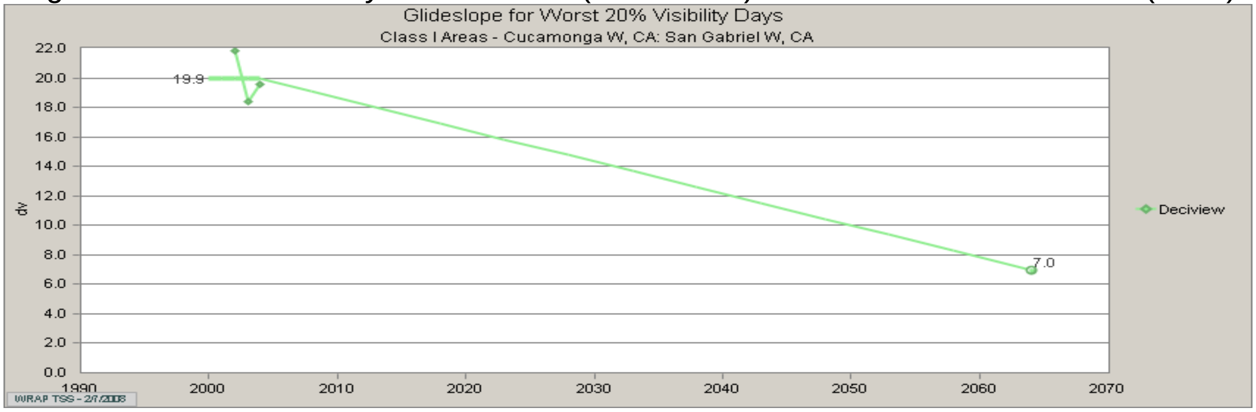
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the SAGA1 monitor is 0.4 deciviews for the 20% best days and 7.0 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 4 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 16.92 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 4.8 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at SAGA1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

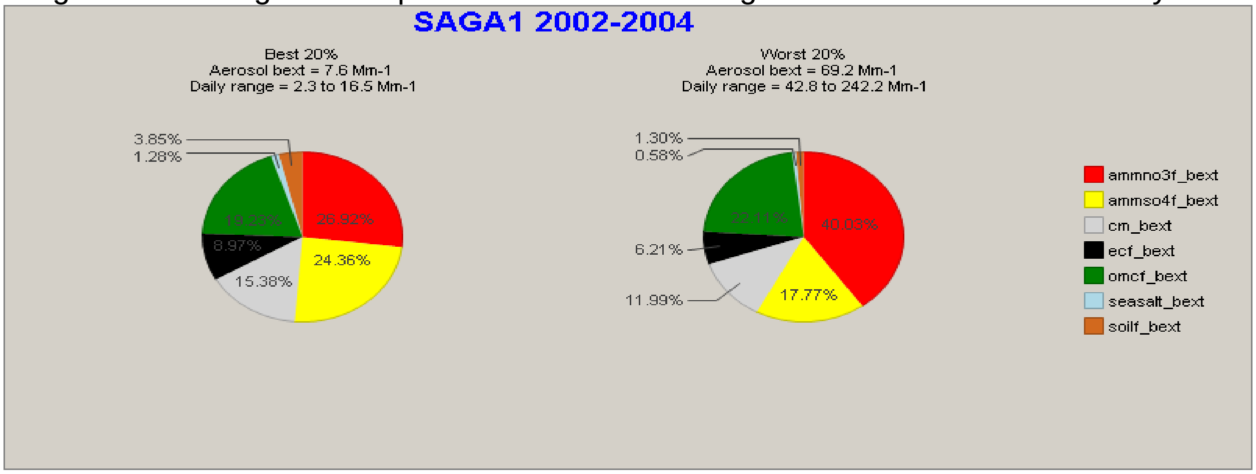
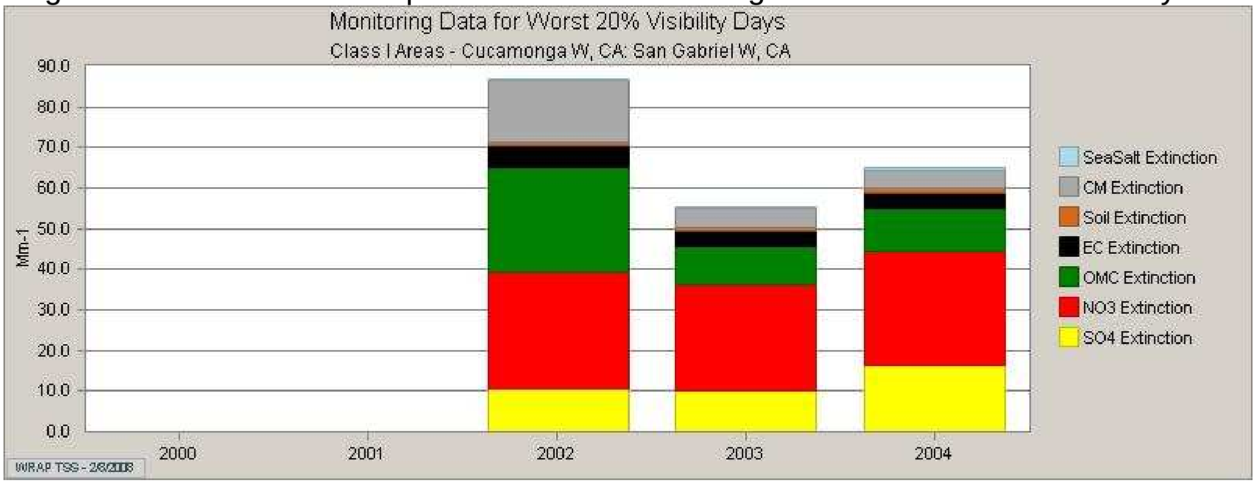


Figure 6. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, nitrates, organic matter, and sulfates have the strongest contributions to light extinction which degrade visibility on worst days at the SAGA1 monitor. The worst days and best days are dominated by nitrates. Data points for 2000 and 2001 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 7 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and spring while sulfates increase slightly in the spring and summer. Organic matter remains stable throughout most of the year but then peaks in August and September of 2002. Nitrate clearly dominates the other haze species on worst days, but organic matter, sulfates, coarse mass and elemental carbon also contribute to the worst days. Sea salt is present in trace amounts at the SAGA1 monitor.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for organic matter, nitrates, sulfates, and coarse mass. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2002

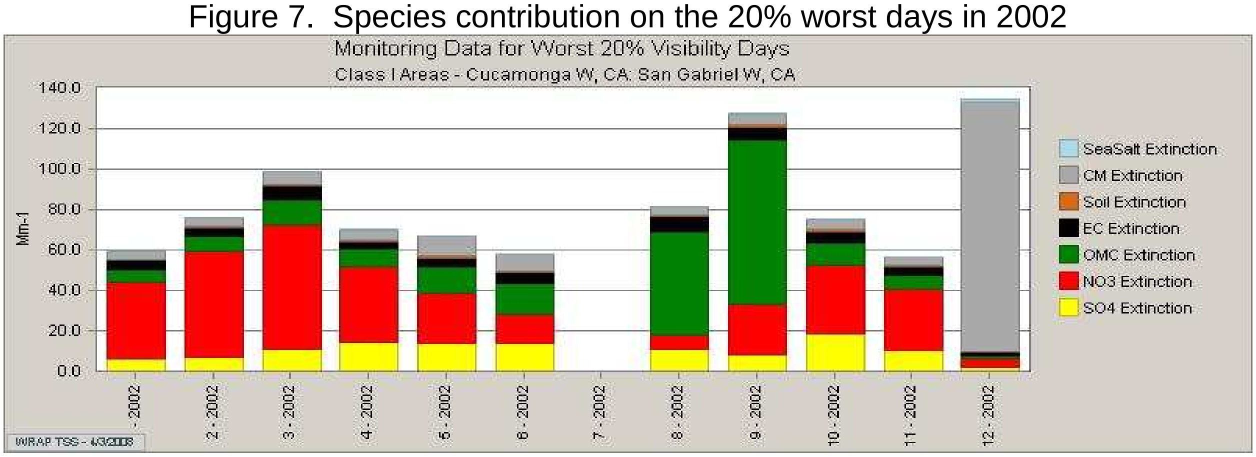
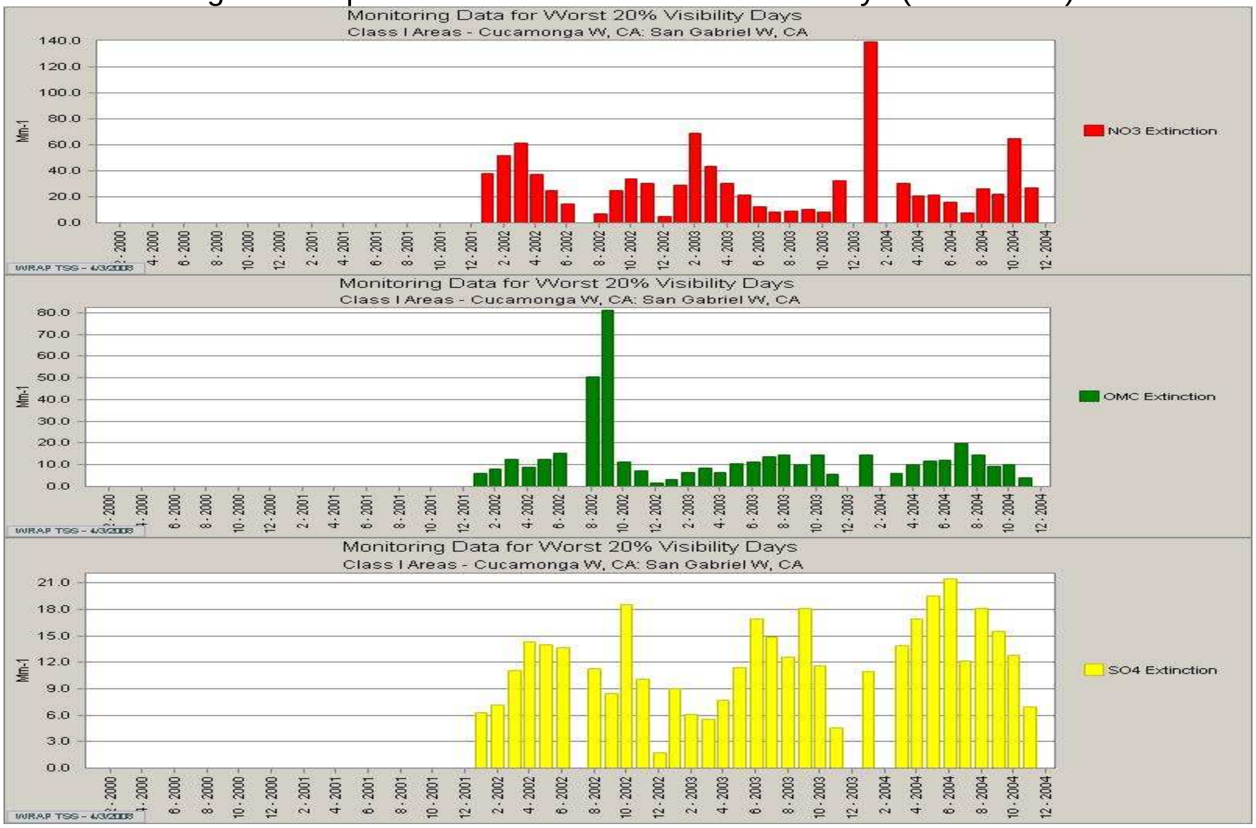


Figure 8. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at SAGA1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 9 and 10 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (78%), followed by the Pacific Offshore Region (18%) and emissions from the Outside Domain (4%). Mobile sources within California contribute the most nitrates at the SAGA1 monitor. In 2002, 76% of the nitrate at the SAGA1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most to nitrate concentrations at the SAGA1 monitor in 2002 and 2018. Currently, California Mobile sources are 81% of California contributions to nitrate at the SAGA1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 11 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the SAGA1 monitor is from natural fire sources within California. California represents 99% of all natural fire source contributions.

Figure 12 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 80% of the total organic carbon. Biogenic secondary emissions account for 14% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 13 and 14 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at SAGA1. The WRAP region represents 43% of the sulfate contributions in 2002 and 2018, followed by the emissions from the Pacific Offshore Region (33%) and the Outside Domain Region (22%). California contributes 36% of the total sulfate emissions seen at the SAGA1 monitor.

Individually, emissions from area sources in the Pacific Offshore contribute the most to sulfate concentrations at the SAGA1 monitor. The next largest contributor to sulfate concentrations is from outside the modeling domain.

Figure 9. Regional Nitrate Contribution to Haze in 2002 and 2018

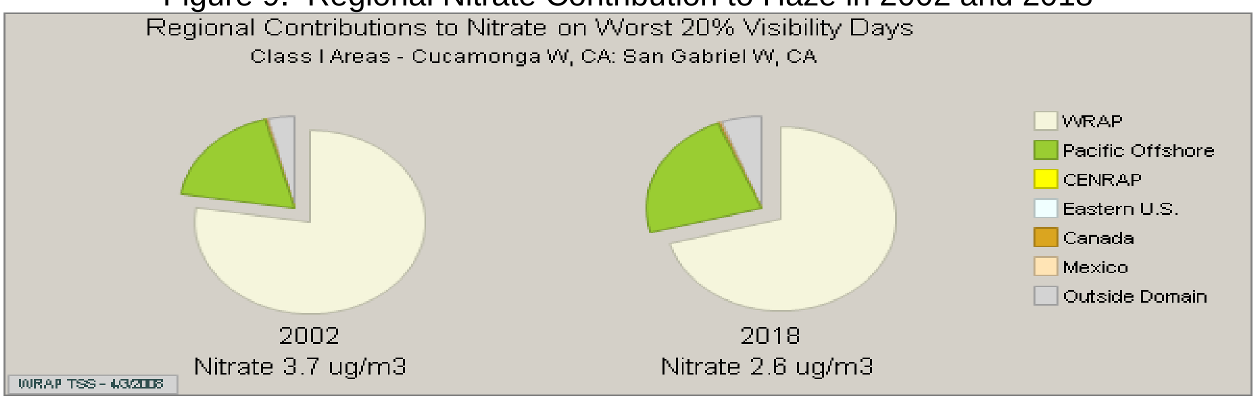


Figure 10. Nitrate source contribution from CA and outside regions

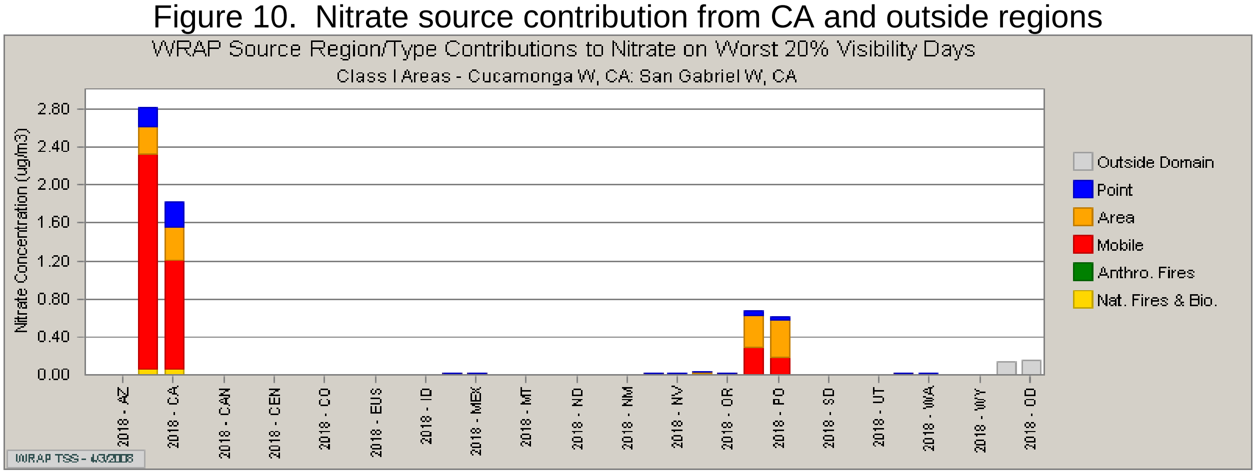


Figure 11. Organic carbon source contribution from CA and outside regions

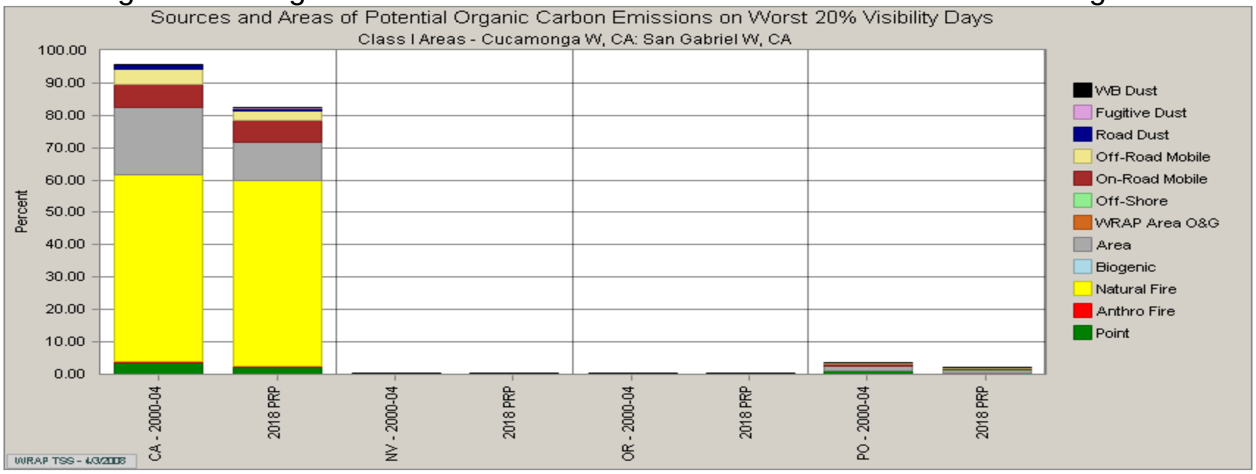


Figure 12. Organic carbon Anthropogenic and Biogenic Source Apportionment

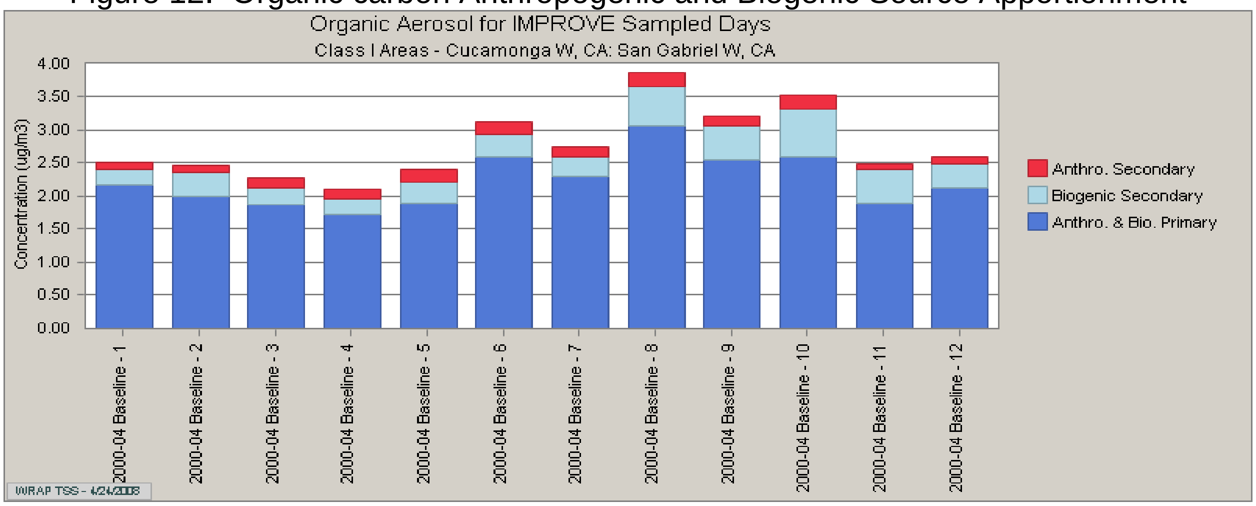


Figure 13. Regional Sulfate Contribution to Haze in 2002 and 2018

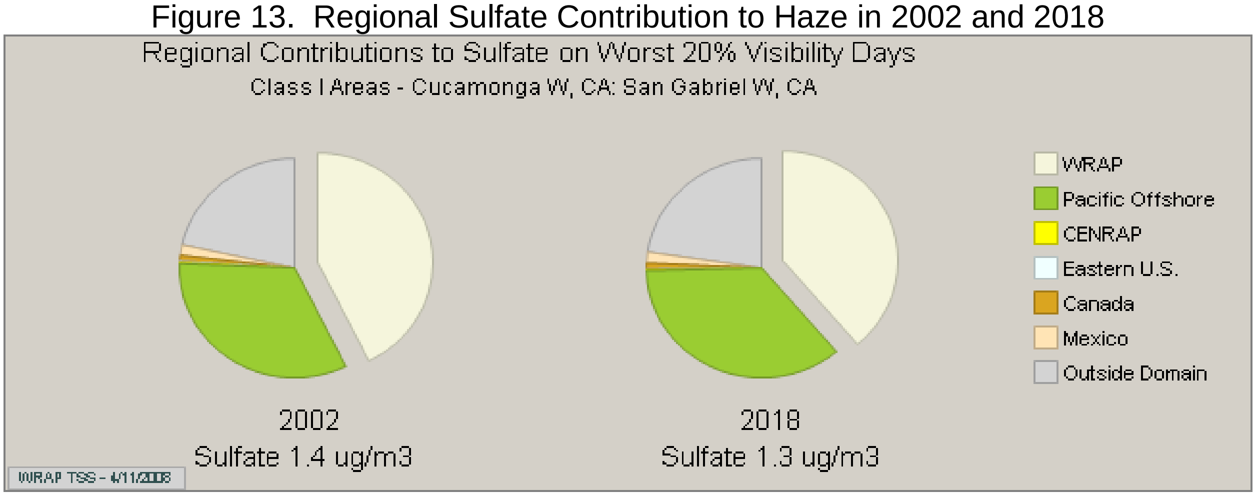
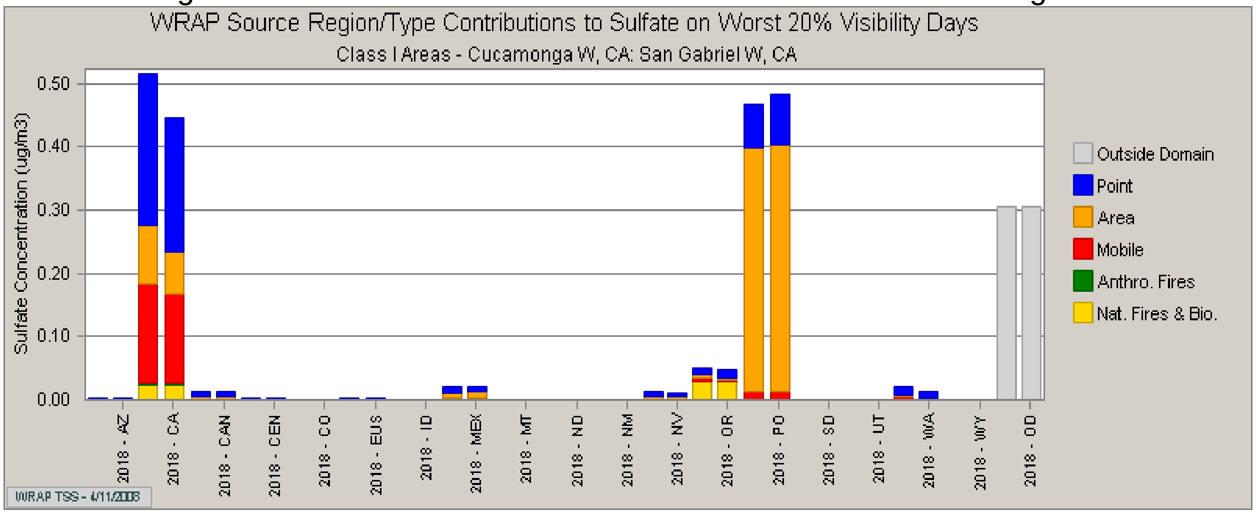


Figure 14. Sulfate source contribution from CA and outside regions



SAGO1 Monitor

The SAGO1 monitor location represents two wilderness areas located in the San Bernardino and San Jacinto Mountains in Southern California. The wilderness areas associated with the SAGO1 monitor are San Gorgonio Wilderness Area and San Jacinto Wilderness area. The SAGO1 site has been operating since March 1988. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2000.

<u>Section I. SAGO1 Wilderness Area Descriptions</u>

I.a. San Gorgonio Wilderness Area

The San Gorgonio Wilderness Area (San Gorgonio) occupies 34,644 acres of the San Bernardino Mountains of southern California, approximately 75 miles east of Los Angeles. Elevations range from 1,341 meters to 3,505 meters at the crest of Mt. San Gorgonio; however most of the wilderness is above the 2,134 meter level. Eleven of the 12 peaks in the Wilderness are above 3,048 meters. Two rivers, the Santa Ana and the White, flow out of the Wilderness. Two small lakes, several meadows, and large, heavily forested areas provide a beautiful sub-alpine oasis in the dry lands that surround the mountain range.

Figure 1. SAGO1 Monitor location

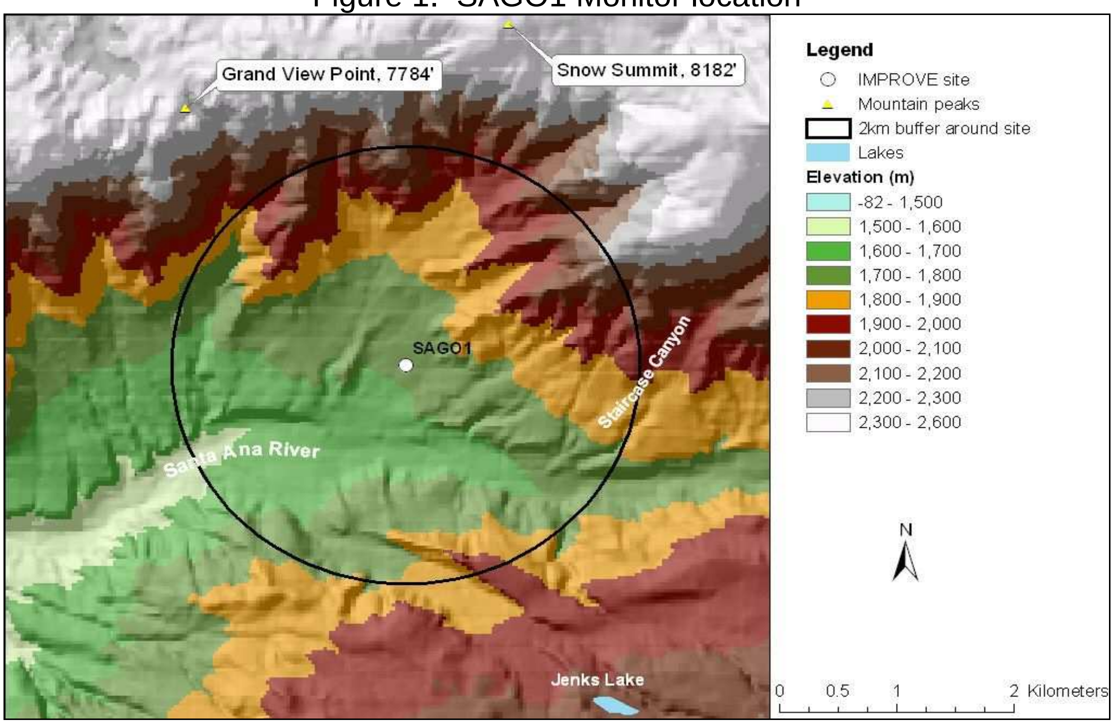


Figure 2. WINHAZE image of San Gorgonio Wilderness Area (5.4 vs. 22.2 dv)

I.b. San Jacinto Wilderness Area

The San Jacinto Wilderness Area (San Jacinto) is part of the San Jacinto Mountains in southern California, adjacent to the Los Angeles Basin to the west, which can be seen from its higher elevations. It is one of the Peninsular Ranges that extend south from the Los Angeles Basin to the tip of the Baja Peninsula and separate the Los Angeles Basin from the Mohave Desert to the east. It occupies 20,564 acres and is split into a north Wilderness and a south Wilderness, separated by the Mount San Jacinto State Park and Wilderness. It is separated from the San Bernardino Mountains and San Gorgonio Wilderness by San Gorgonio Pass. Elevations range from less than 610 meters on the north edge within San Gorgonio Pass to almost 3,353 meters at its higher peaks. The highest peak in the area is San Jacinto Peak located between the north and south Wilderness sections, at an elevation of 3,293 meters.

Figure 3. San Jacinto Wilderness Area

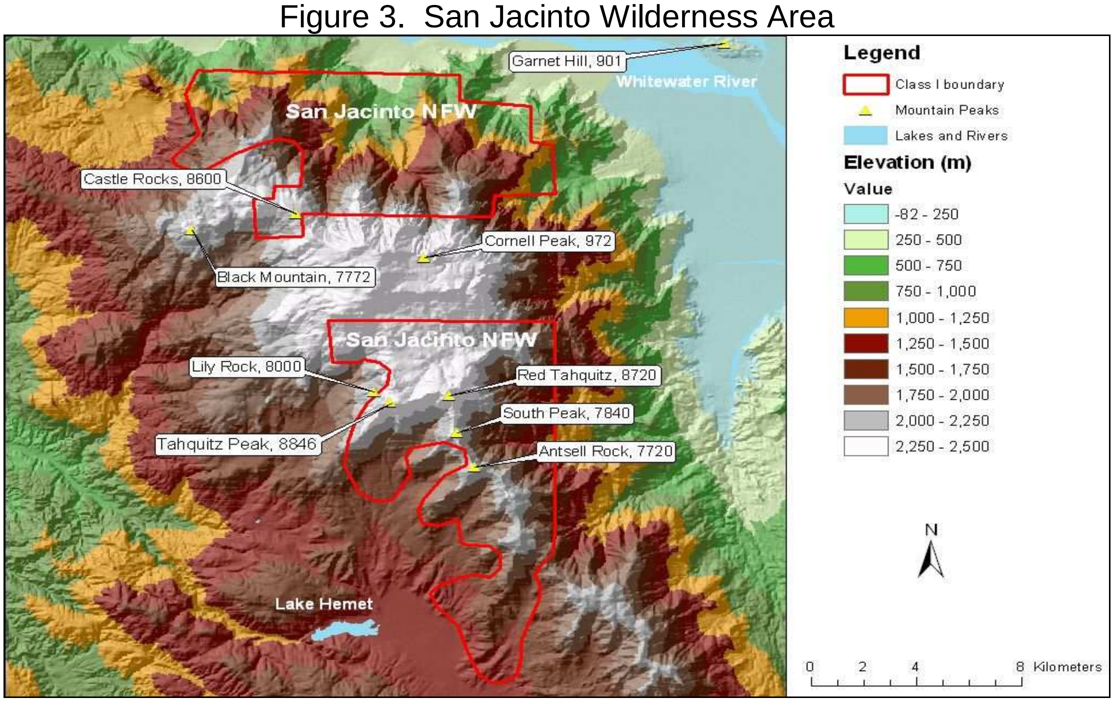


Figure 4. Photograph of San Jacinto Wilderness Area

Figure 5. SAGO1 Monitor location in California

Section II. Visibility Conditions:

II.a. San Gorgonio Wilderness Area

Visibility conditions for San Gorgonio are currently monitored by the SAGO1 IMPROVE monitor. The monitor is located at 34.1939 north latitude and 116.9132 west longitude, in the upper Santa Ana River valley north of the northern San Gorgonio boundary. The orientation of the Santa Ana River valley is west to east, with its mouth to the west, exiting into the Los Angeles basin. The valley bottom location nearest the site is about 1,646 meters, just south of the monitoring site. Elevations rise to about 2,347 meters at the ridge crest, about 2 miles north, and to about 2,987 meters at the ridge crest about 7 miles south of the site.

The SAGO1 IMPROVE site is near the bottom of the Santa Ana River valley at an elevation Off 1,726 meters. This is well below typical San Gorgonio elevations which extend to over 3,048 meters on some of the peaks. Aerosol composition and concentration measured at SAGO1 may not be representative of higher San Gorgonio elevations. When the atmosphere is well mixed to San Gorgonio elevations the SAGO1 site should be representative.

The SAGO1 location is adequate for assessing the 2018 reasonable progress goals for the San Gorgonio Wilderness Class 1 area.

II.b. San Jacinto Wilderness Area

Visibility conditions for San Jacinto are currently monitored by the SAGO1 IMPROVE monitor in the San Gorgonio Wilderness Area. The monitor is located at 34.1939 north latitude and 116.9132 west longitude north of San Gorgonio Pass in the upper Santa Ana River Valley. The monitor is at an elevation of 1726 meters and about 20 miles north of the Wilderness boundary across the San Gorgonio Pass. It is also separated from the San Jacinto Wilderness by the San Gorgonio Wilderness that includes the so-called "Ten Thousand Foot Ridge", with elevations in excess of 3,048 meters.

The SAGO1 IMPROVE site is near the bottom of the Santa Ana River valley and is separated from the San Jacinto Wilderness by the San Gorgonio Wilderness, which presents a massive intervening obstruction. It should be representative of lower Wilderness elevations when the atmosphere is well mixed, but may not be as representative when it is within a local trapping inversion in the Santa Ana River Valley, or beneath a regional inversion between the SAGO1 elevation and San Jacinto elevations. The San Gorgonio Pass, a potential air pollution corridor between the Los Angeles Basin and the Mohave Desert to the east, also lies between SAGO1 and the San Jacinto Wilderness and could at times create a gradient in concentrations between the SAGO1 monitoring site and San Jacinto Wilderness locations. There could also be a difference in aerosol composition if and when the SAGO1 site is influenced by local sources such as wild land fires.

The SAGO1 location is adequate for assessing the 2018 reasonable progress goals for the San Jacinto Wilderness Class 1 area.

II.c. Baseline Visibility

Baseline visibility is determined from SAGO1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the SAGO1 monitor is calculated at 5.4 deciviews for the 20% best days and 22.2 deciviews for the 20% worst days. Figure 6 represents the worst baseline visibility conditions.

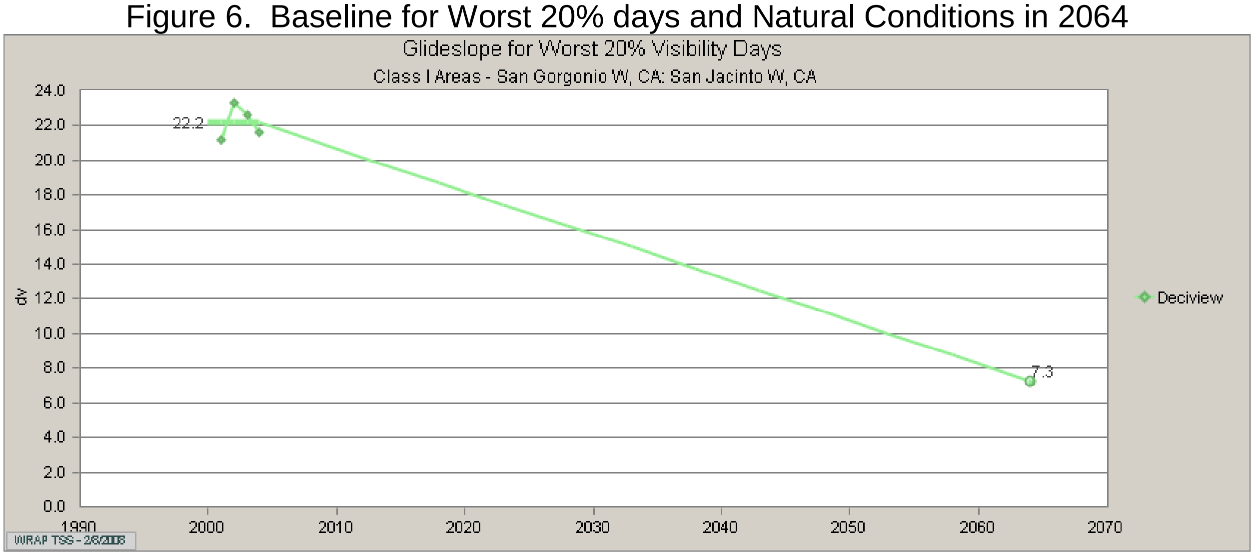
II.d. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the SAGO1 monitor is 1.2 deciviews for the 20% best days and 7.3 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.e. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 6 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 18.70 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 5.4 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 6. Baseline for Worst 20% days and Natural Conditions in 2064



II.f. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 7 shows the contribution of each species to the 20% best and worst days in the baseline years at SAGO1.

Figure 7. Average Haze species contributions to light extinction in the baseline years

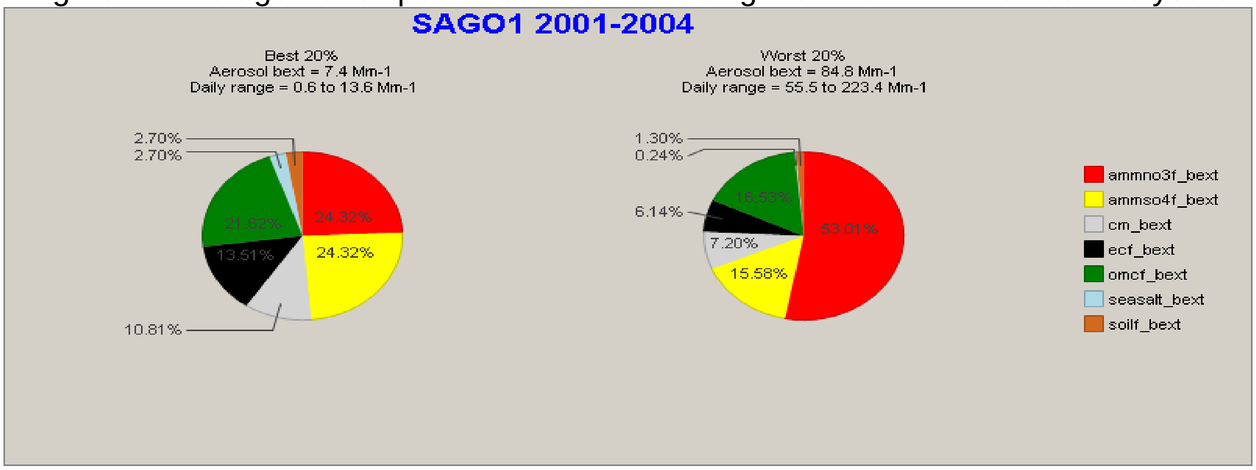
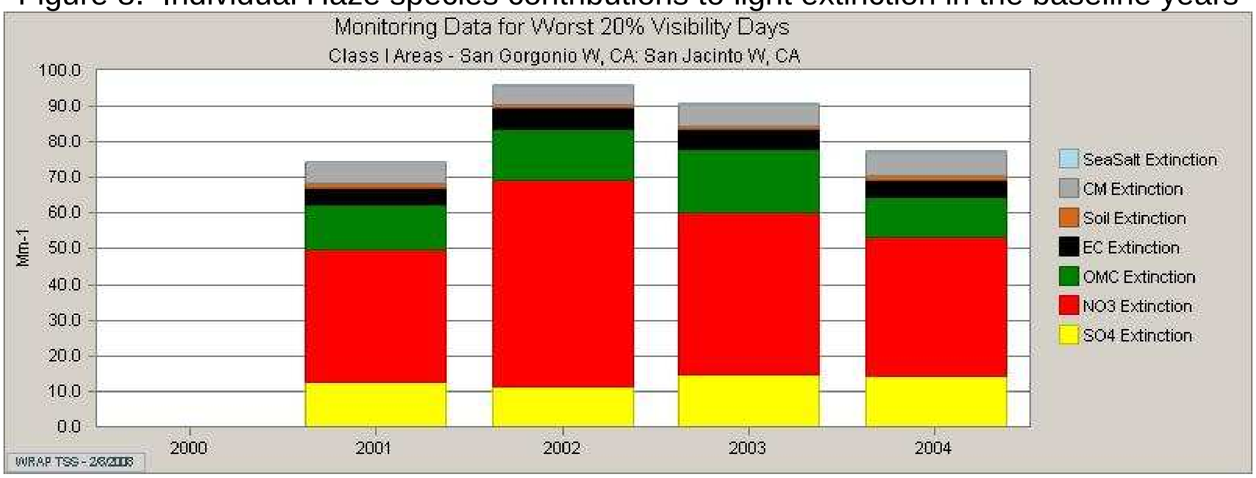


Figure 8. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 7 and 8, nitrates, organic matter, and sulfates have the strongest contributions to degrading visibility on worst days at the SAGO1 monitor. Nitrates clearly dominate on the worst days, but nitrates and sulfates equally contribute emissions on the best days. Data points for 2000 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 9 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and spring months, while organic matter increases in the summer and fall. Sulfates remain relatively stable throughout the year. Nitrates clearly dominate the other haze species on worst days, but organic matter, sulfates, coarse mass and elemental carbon also contribute to the worst days. There are only trace amounts of soil and sea salt present throughout the years.

Figure 10 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 9 for nitrates, organic matter, and sulfates. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 9. Species contribution on the 20% worst days in 2002

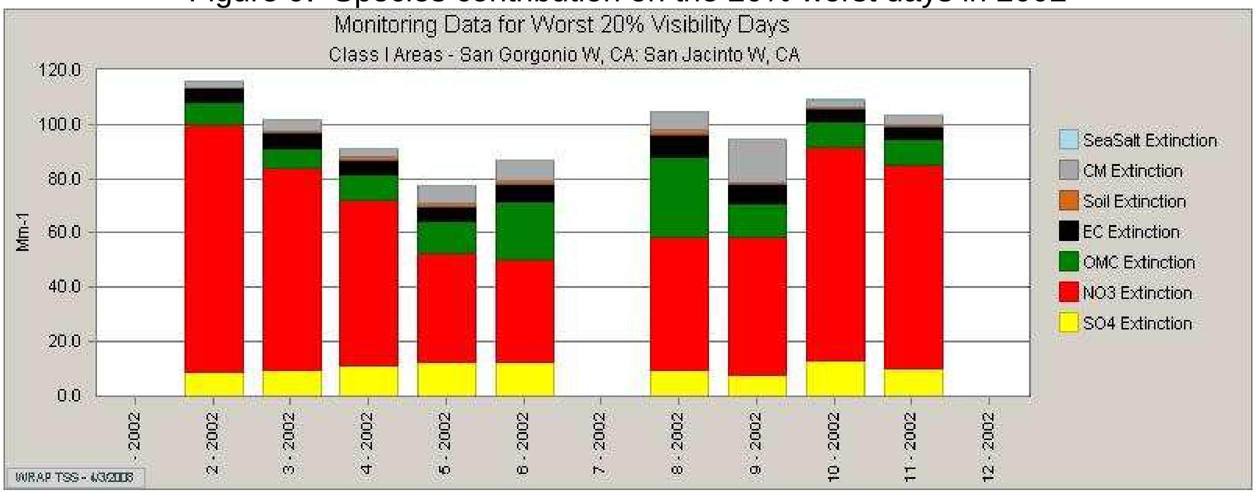
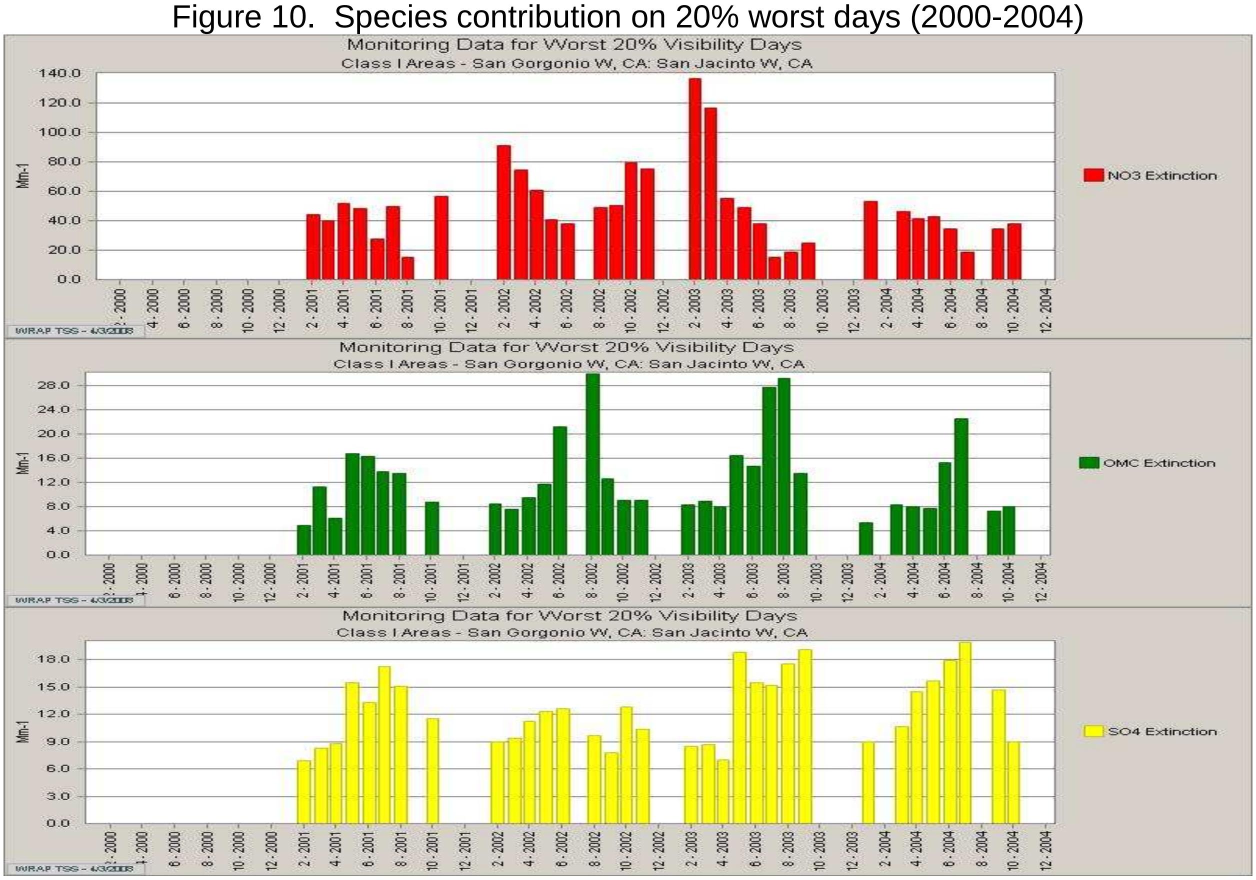


Figure 10. Species contribution on 20% worst days (2000-2004)



II.g. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at SAGO1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether or not they from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 11 and 12 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (79%), followed by the Pacific Offshore Region (17%) and emissions from Outside Domain (3%). Mobile sources within California contribute the most nitrate at the SAGO1 monitor. In 2002, 87% of the nitrate from mobile sources at the SAGO1 monitor can be attributed to California. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 13 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the SAGO1 monitor is from natural fire sources within California. California represents 99% of all natural fire source contributions.

Figure 14 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 59% of the total organic carbon. Biogenic secondary emissions account for 34% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figures 15 and 16 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at SAGO1. The WRAP region represents 38% of the sulfate contributions in 2002 and 2018, followed by the emissions from Pacific Offshore (31%) and the Outside Domain Region (27%). California contributes 33% of the total sulfate emissions seen at the SAGO1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the SAGO1 monitor. The next largest contributor to sulfate concentrations is area sources in the Pacific Offshore.

Figure 11. Regional Nitrate contribution to haze in 2002 and 2018

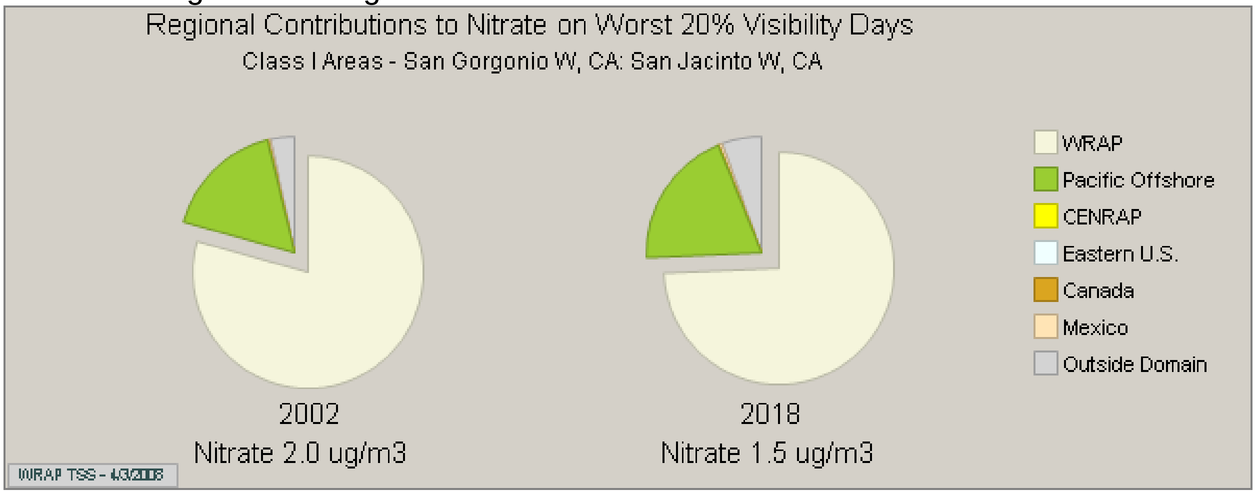


Figure 12. Nitrate source contribution from CA and outside regions

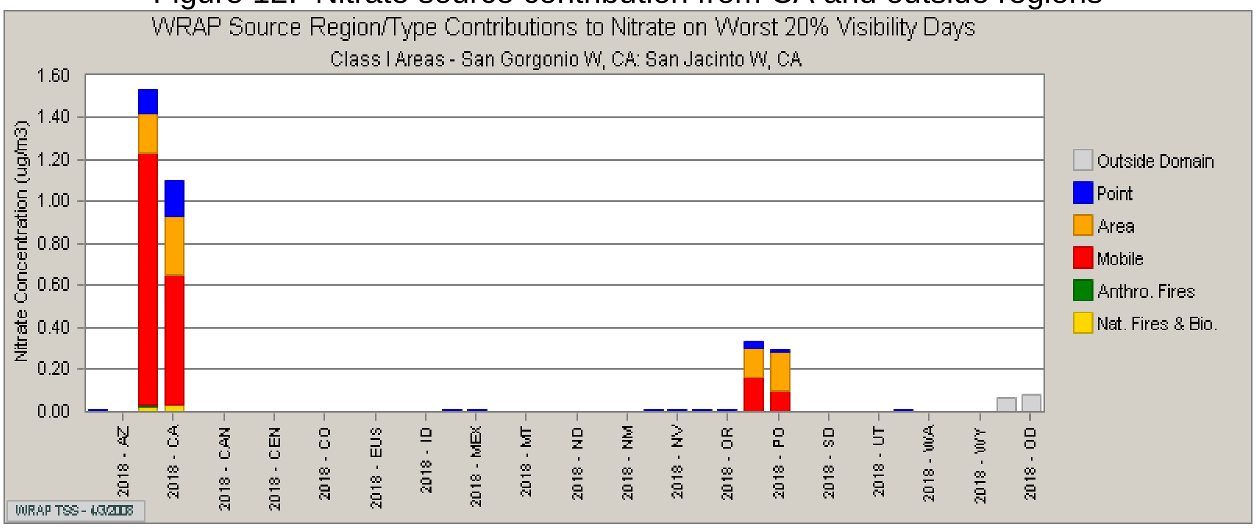


Figure 13. Organic carbon source contribution from CA and outside regions

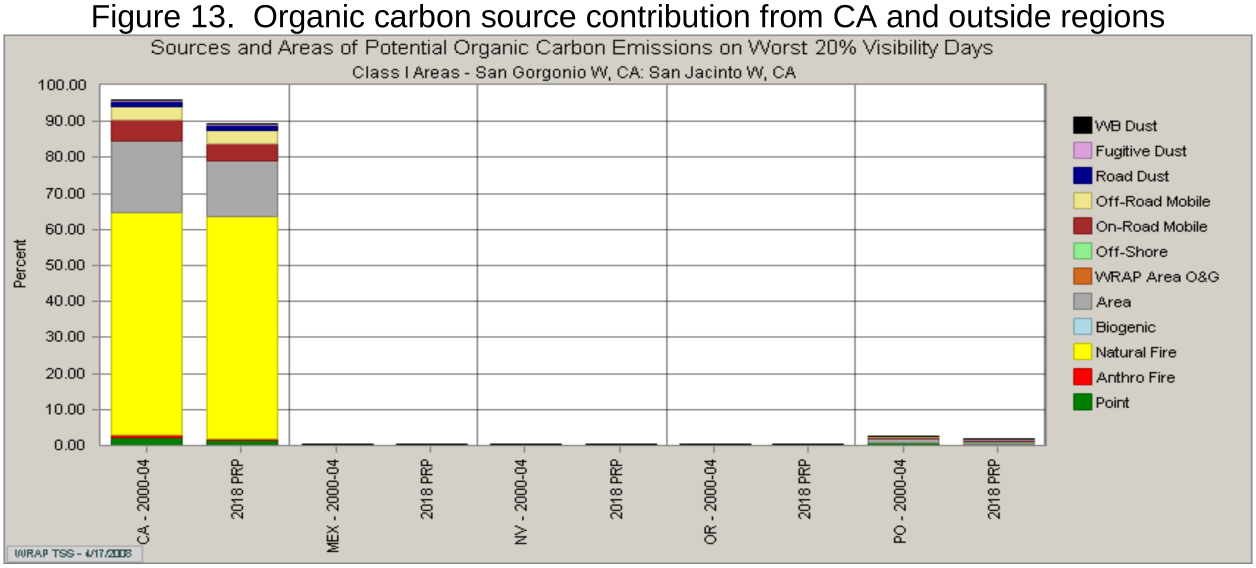


Figure 14. Organic carbon Anthropogenic and Biogenic Source Apportionment

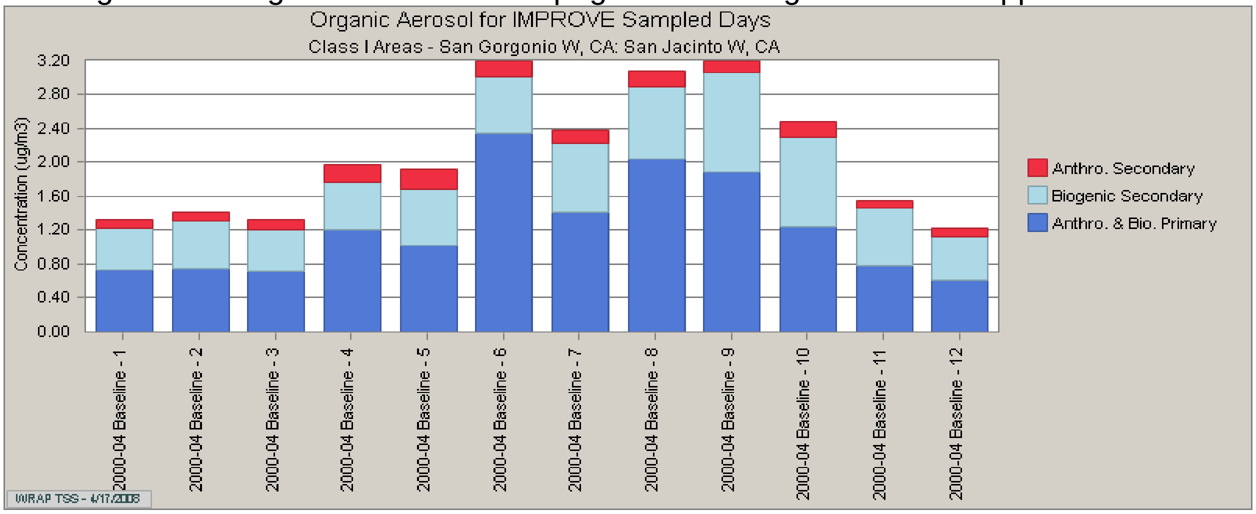


Figure 15. Regional Sulfate contribution to haze in 2002 and 2018

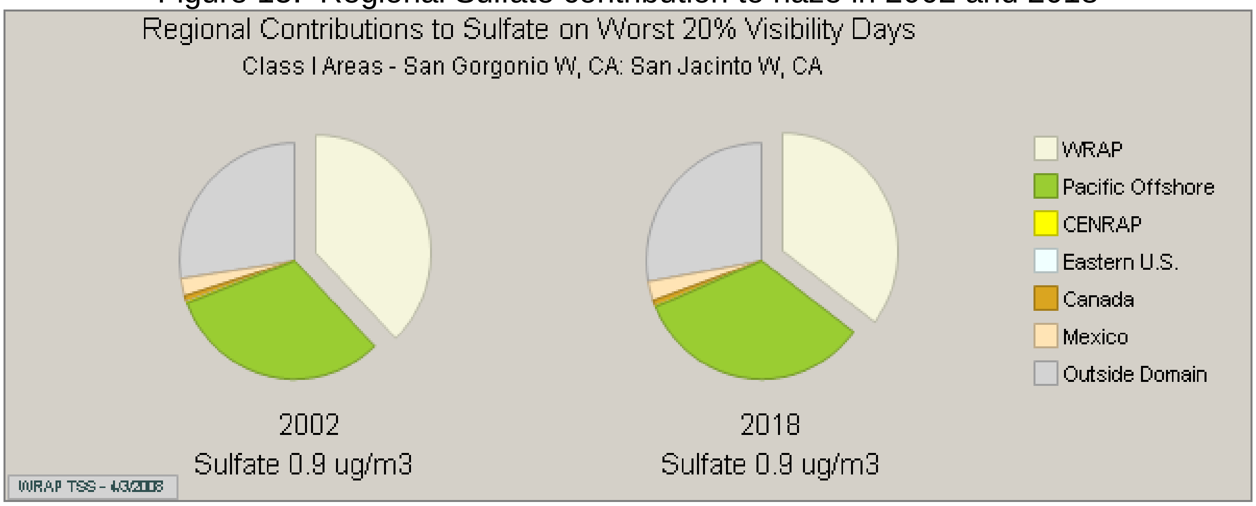
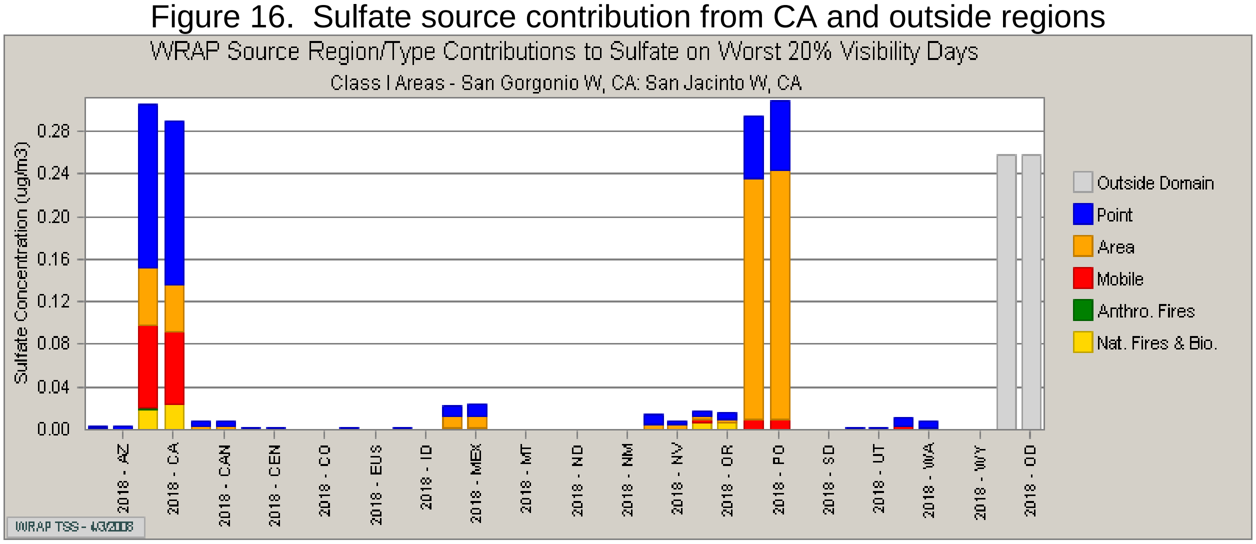


Figure 16. Sulfate source contribution from CA and outside regions



AGT1 Monitor

Section I. Description

The Agua Tibia Wilderness Area comprises most of the Cleveland National Forest, 15,934 acres, in the northwest part of the isolated Palomar Mountain Range of southern California. The area is mountainous, cut by many deep canyons that reach downward towards flatter terrain of coastal southern California between Los Angeles and San Diego. Elevations range from nearly 518 meters in the canyon bottoms, to the 1547 meters Eagle Crag Peak at the southeast corner of the Wilderness Area, although there are higher elevations along the main part of the Palomar Range extending further to the southeast. West of the Wilderness, canyons exit into the San Luis Rey River drainage that empties into the Pacific Ocean near Oceanside, about 30 miles southwest of the Wilderness.

Figure 1. AGT1 Monitor location

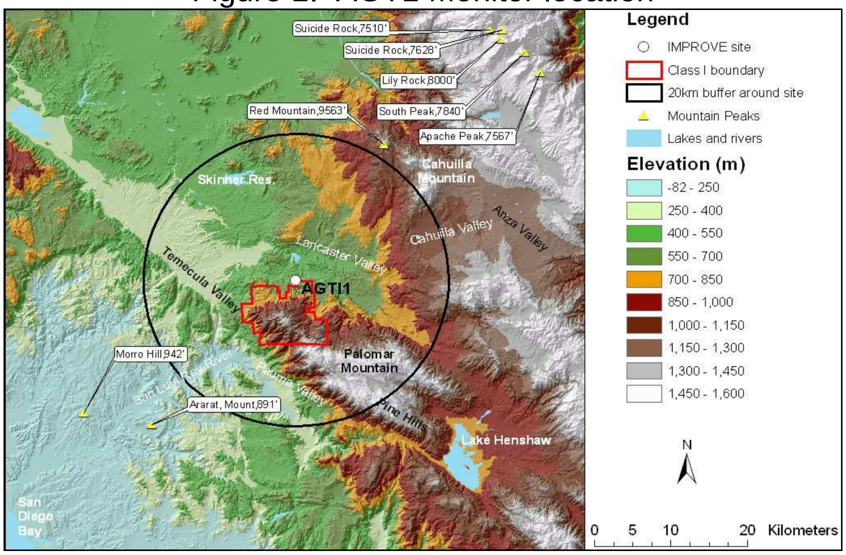


Figure 2. Image of Agua Tibia

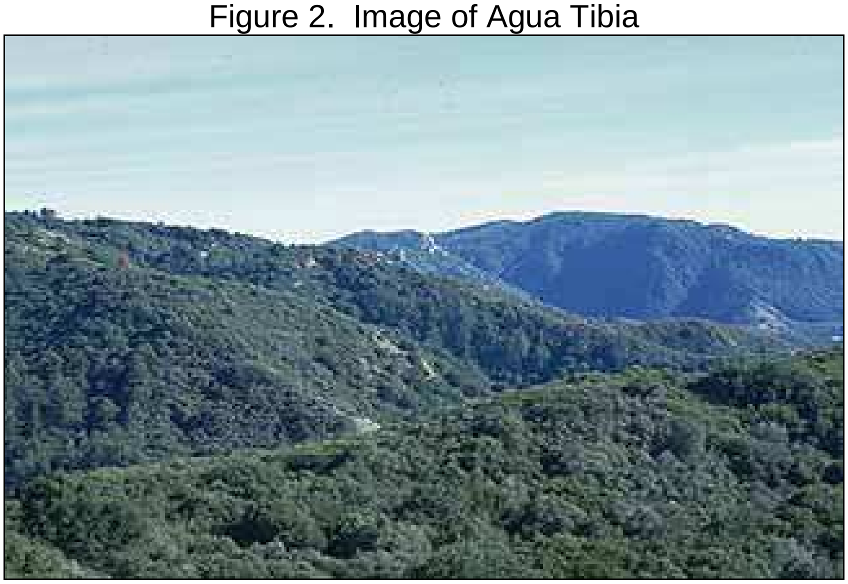


Figure 3. AGT1 Monitor location in California

Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for Agua Tibia are currently monitored by the AGTI1 IMPROVE monitor. The monitor is located at 33.46 north latitude, 116.97 west longitude, close to Highway 79 near the northern Wilderness boundary at an elevation of 508 meters (which is near the lower end of the range of Wilderness elevations). It is also within the typical elevation range for the transition zone between the coastal marine layer and the drier air above. The elevation range for this transition zone is typically 305 to 610 meters. The site has been operating since November 2000. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2000.

The Agua Tibia monitoring site is at an elevation of 508 meters, thus very representative of lower Agua Tibia Wilderness elevations in general. At this elevation it may at times be within the coastal marine inversion, if and when the inversion extends inland to this site. In such cases it would be less representative of higher Wilderness elevations above the penetrating marine layer. The Wilderness is above the foothills of the sprawling and heavily populated and industrialized South Coast Air Basin immediately to the north. The Temecula Valley just to the west of the Wilderness is a rapidly growing area, and associated urban emissions may also have increasing impact on aerosol concentrations in the Agua Tibia Wilderness.

The AGTII location is adequate for assessing the 2018 reasonable progress goals for the Agua Tibia Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from AGTI1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the Agua Tibia Wilderness is calculated at 9.6 deciviews for the 20% best days and 23.5 deciviews for the 20% worst days. Figure 4 represents the worst baseline visibility conditions.

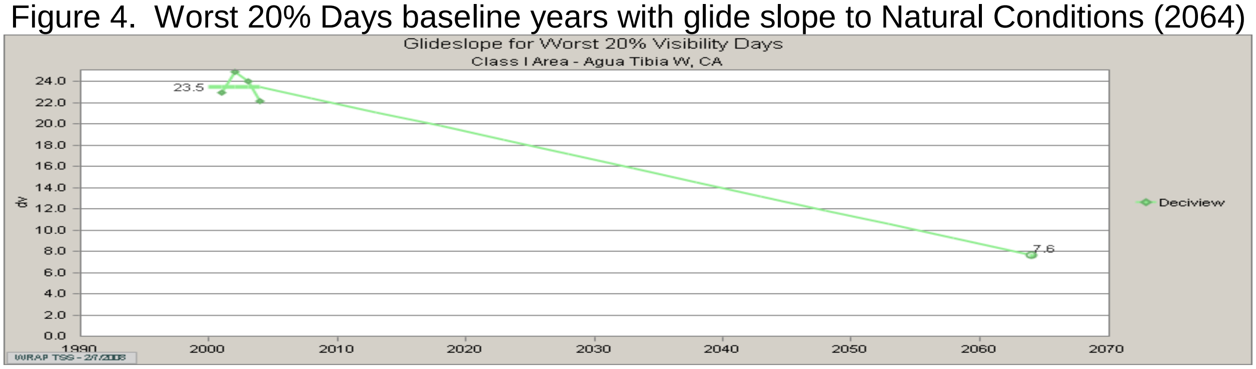
II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the Agua Tibia Wilderness is 2.9 deciviews for the 20% best days and 7.6 deciviews for the 20% worst days. It is possible that the Natural conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 4 also shows the uniform rate of progress, or “glide slope.” The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 19.8 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 9.6 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% Days baseline years with glide slope to Natural Conditions (2064)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at AGTI1.

Figure 5. Average Haze Species contributions to light extinction in the baseline years

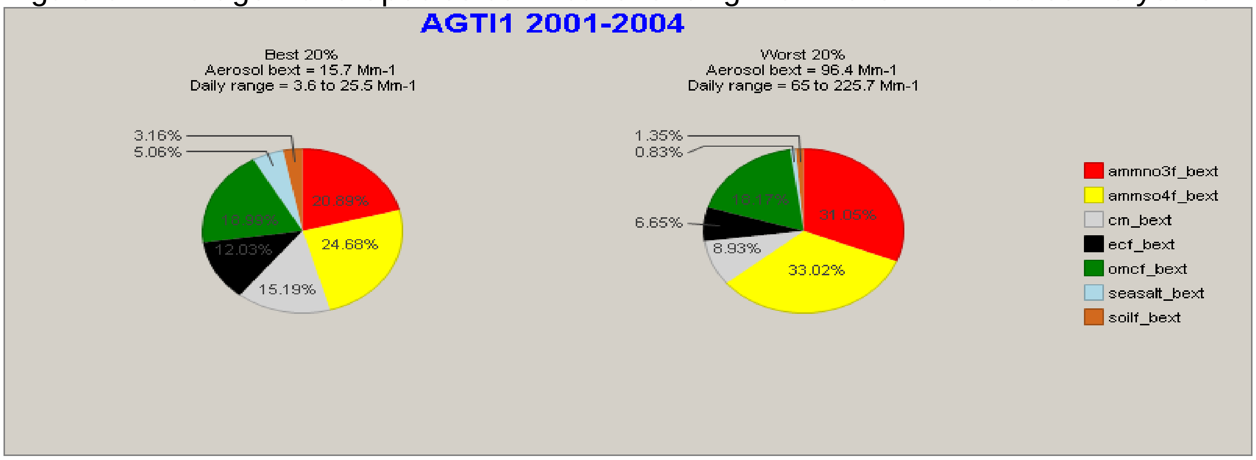
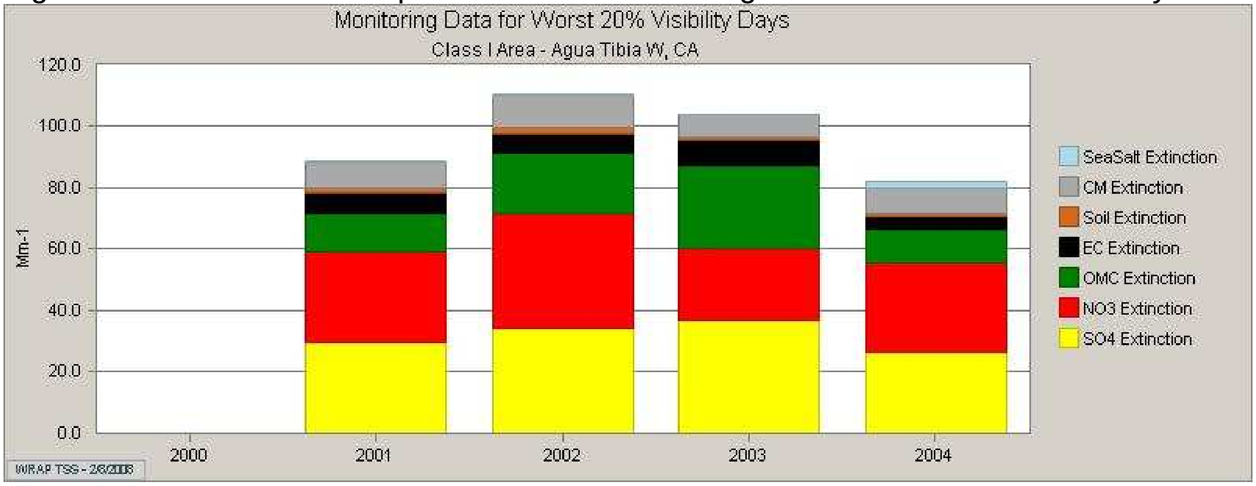


Figure 6. Individual Haze Species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, sulfates, nitrates, and organic matter have the strongest contributions to degrading visibility on worst days at Agua Tibia Wilderness Area. Data points for 2000 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 7 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and spring months. Sulfates remain relatively stable throughout the year but do increase slightly in July and August. The occurrence of elevated organic matter concentrations is sporadic throughout the year. Nitrates clearly dominate the other haze species on worst days, but sulfate and organic matter also contribute to the worst days in the summer. There are also small amounts of coarse mass and elemental carbon present throughout the years.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for nitrates, sulfates, and organic matter. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2002

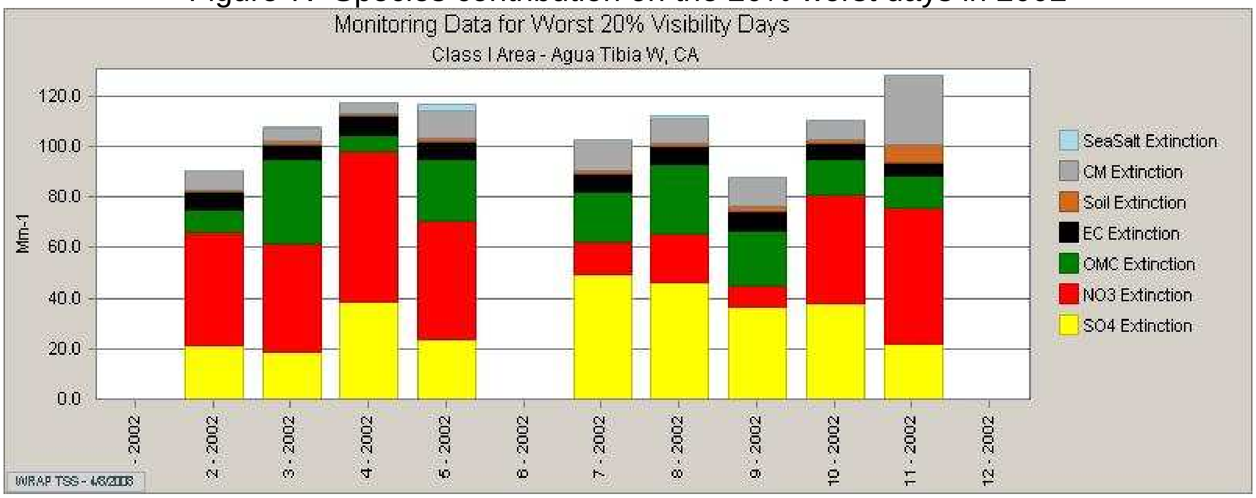
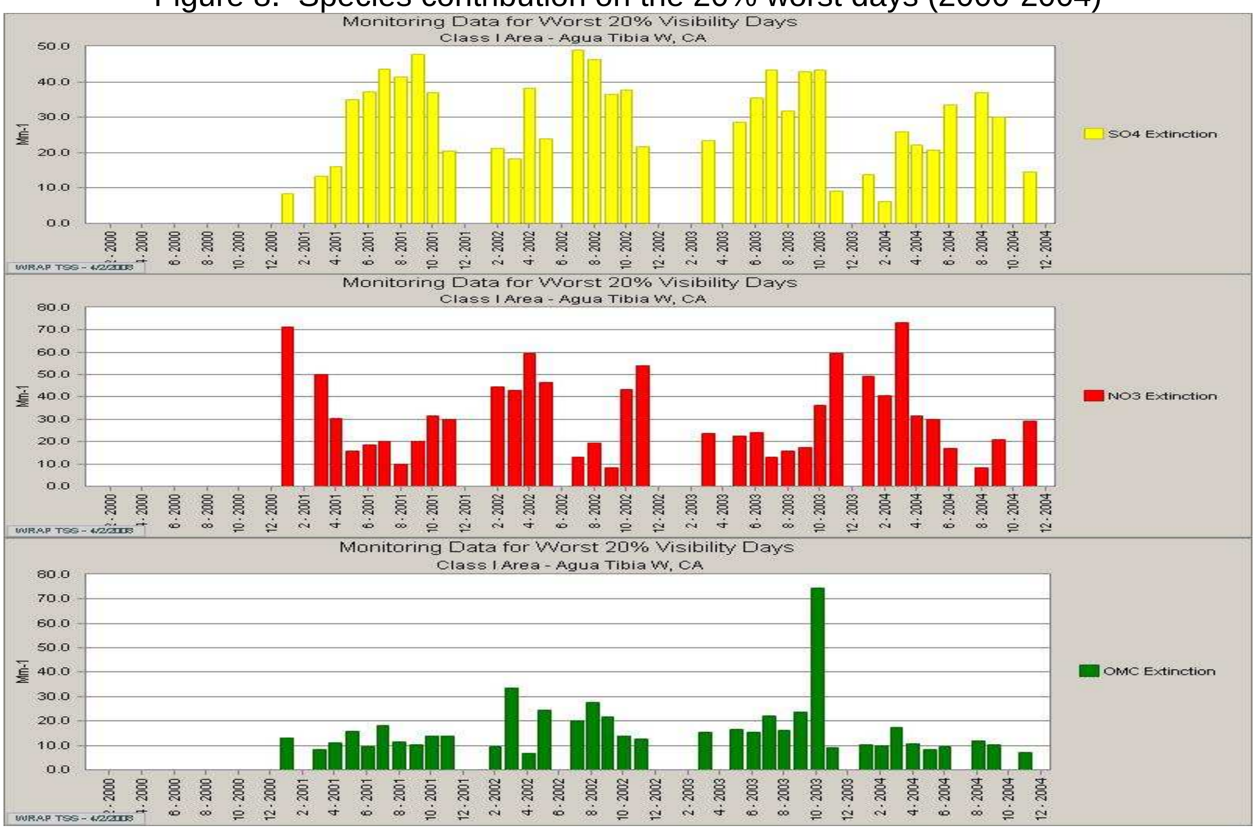


Figure 8. Species contribution on the 20% worst days (2000-2004)



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at AGTI1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 9 and 10 represent the regional contributions to sulfate on the 20% worst days. The Pacific Offshore region represents the largest contribution to sulfate in 2002 and 2018 (50%), followed by the WRAP Region (28%) and emissions from outside the modeling domain (17%). In 2002, 23% of the sulfate at the AGT1 monitor can be attributed to California. From the WRAP region, California is shown to contribute the most to sulfate concentrations at the AGT1 monitor in 2002 and 2018. Area sources represent 39% of all sulfate categories at the AGT1 monitor.

Individually, emissions from area sources from the Pacific Offshore contribute the most to sulfate concentrations at the AGT11 monitor. The next largest contributor to sulfate concentrations is point sources in the Pacific Offshore.

Figures 11 and 12 represent the regional contributions of nitrate on the 20% worst days in 2002 and 2018 at AGT1. The WRAP Region represents the largest contribution to nitrate in 2002 and 2018 (72%) followed by the Pacific Offshore Region (24%) and emissions from outside the modeling domain (3%). In 2002, 70% of nitrate at the AGT1 monitor can be attributed to California.

From the WRAP Region, California is shown to contribute the most nitrate concentrations at the AGT1 monitor in 2002 and 2018. Currently, California mobile sources are 82% of California contributions to nitrate at the AGT1 monitor. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figure 13 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the AGT1 monitor is from natural fire within California. California represents 98% of all natural fire source contributions.

Figure 14 illustrates the total Organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 59% of the total organic carbon. Biogenic secondary emissions account for 35% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining 6% of emissions.

Figure 9. Regional Sulfate contribution to Haze in 2002 and 2018

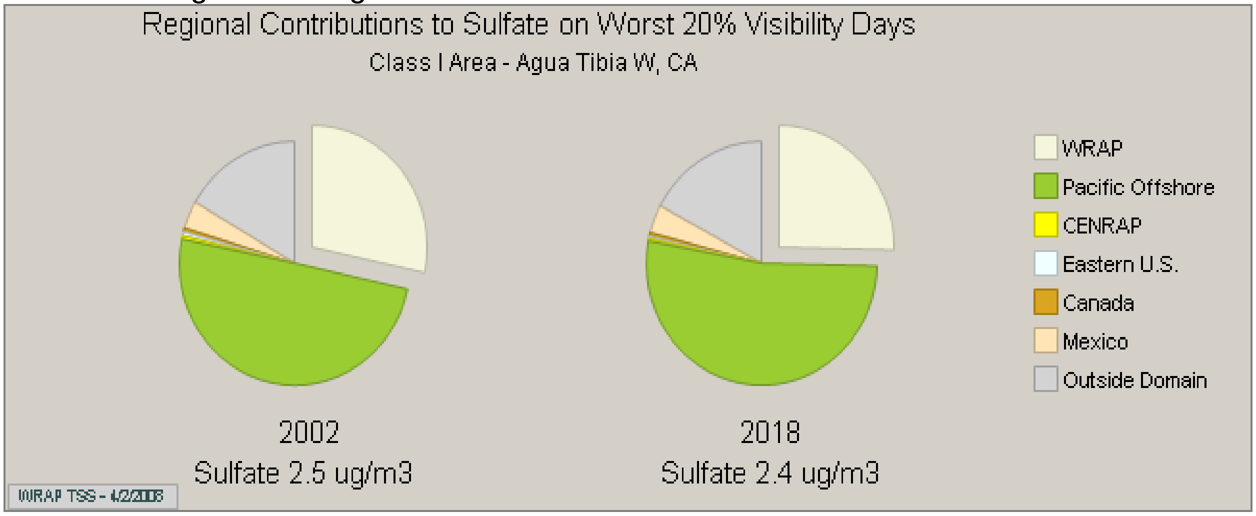


Figure 10. Sulfate source contribution from CA and outside regions

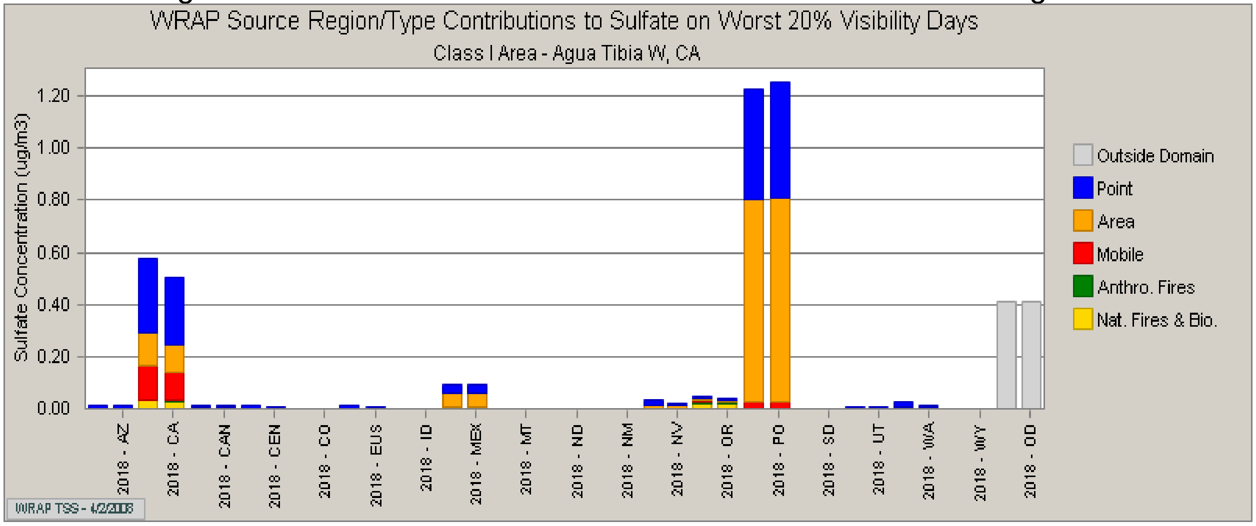


Figure 11. Regional Nitrate contribution to Haze in 2002 and 2018

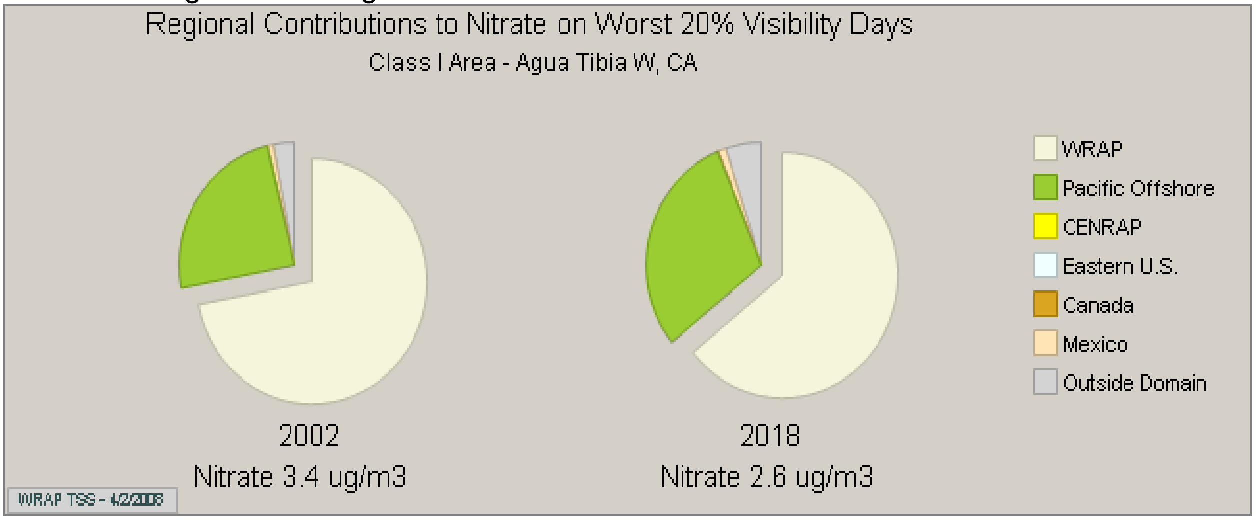


Figure 12. Nitrate source contribution from CA and outside regions

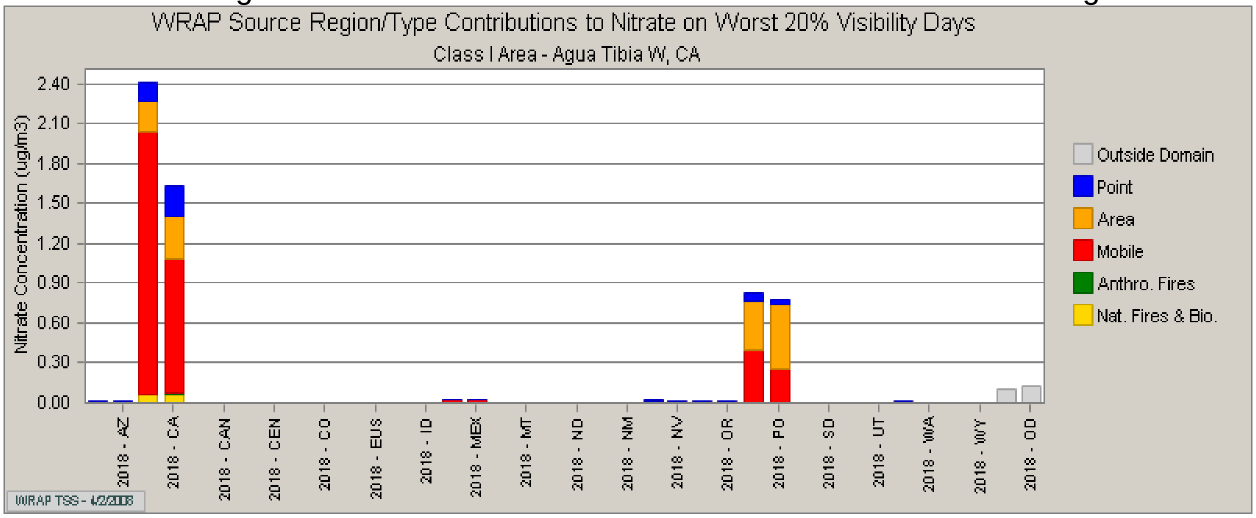


Figure 13. Organic carbon source contribution from CA and outside regions

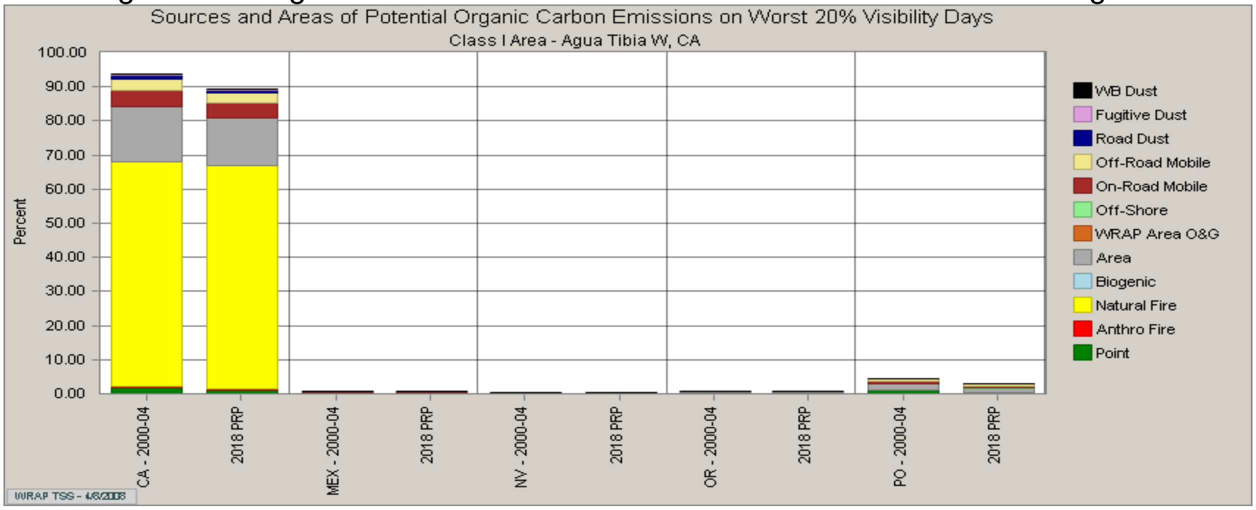
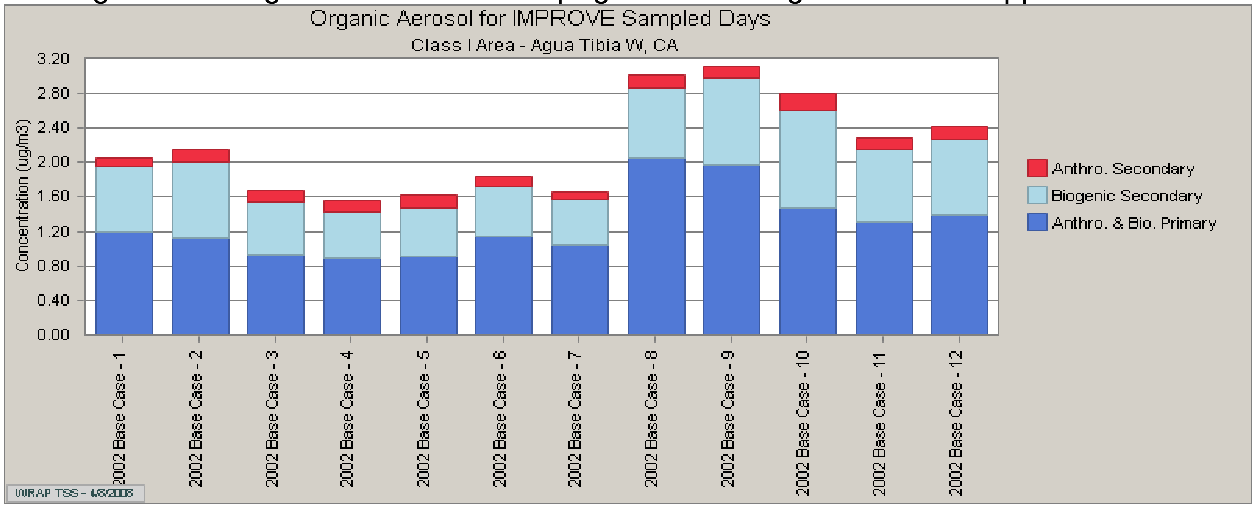


Figure 14. Organic Carbon Anthropogenic and Biogenic Source Apportionment



JOSH1 Monitor

Section I. Description

The Joshua Tree Wilderness Area consists of 429,690 acres within Joshua Tree National Park located in the eastern extent of the Mohave Desert of southern California, with the eastern portions also within the Sonoran Desert Physiographic province. It occupies a portion of the Little San Bernardino Mountains. Elevations range from just under 198 meters in the easternmost portions to near 960 meters at the highest peaks that include Quail Mountain in the west and Monument Mountain in the central portion. The eastern portion of the National Park consists of the dry Pinto Wash that drains to the east. Just to the west is the Whitewater River valley that includes the city of Palm Springs and urban areas near Banning. San Gorgonio Pass is also just west of the Wilderness and National Park. San Gorgonio Pass forms a break between the San Bernardino Mountains to the north and the San Jacinto Mountains to the south and is a natural corridor of air transport between the Mohave Desert and the eastern portions of the South Coast Air Basin.

Figure 1. Joshua Tree National Park

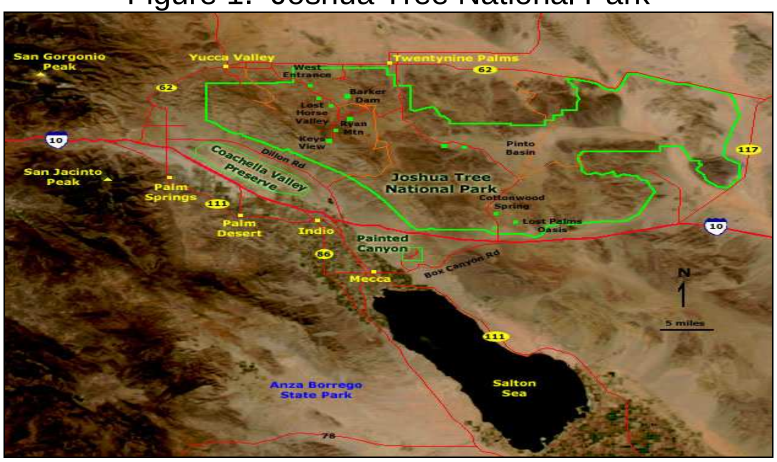


Figure 2. Joshua Tree National Park

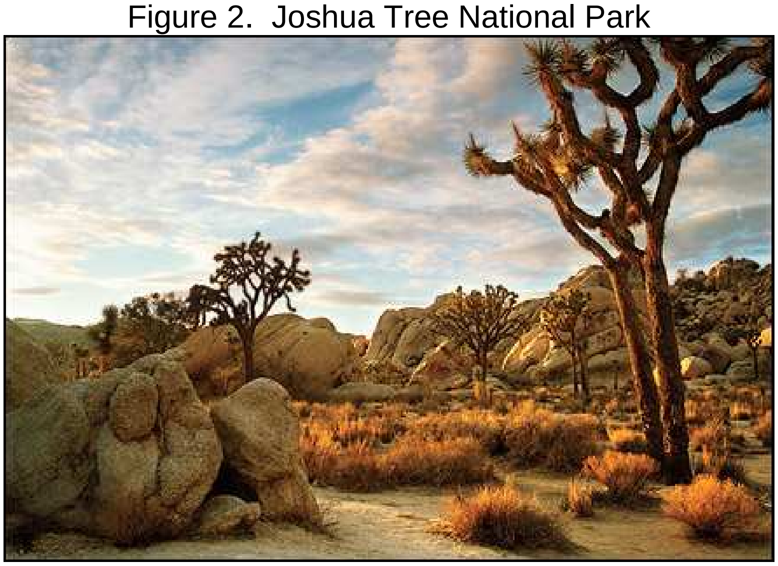


Figure 3. JOSH1 Monitor location in California

Section II. Visibility Conditions:

II.a. Visibility Monitor Location

Visibility conditions for the Joshua Tree Wilderness are currently monitored by the JOSH1 IMPROVE monitor. The monitor is located at 34.0695 north latitude and 116.3889 west longitude, near the northwestern Wilderness boundary at an elevation of 1235 meters. The site is close to the wilderness boundary on the west side and is at an elevation near the midrange of wilderness elevations. It should be very representative of aerosol characteristics within the Joshua Tree Wilderness Area. This site does not have sufficient data for the entire baseline period. Data was not available for the year 2000.

Nearby population centers include the Palm Springs area to the west and developed land near the northern boundary. Joshua Tree Wilderness is also near San Gorgonio Pass, which presents a potential corridor for emissions from the eastern South Coast Air Basin to the west. Potential transport routes into the Joshua Tree Wilderness include long distance transport via upward mixing from more distant source regions and transport into the region via upper level flow. Possible source regions include the South

Coast Air Basin to the west and surrounding desert terrain, especially to the north and east, as a source for windblown dust.

The JOSH1I location is adequate for assessing the 2018 reasonable progress goals for the Joshua Tree Wilderness Class 1 area.

II.b. Baseline Visibility

Baseline visibility is determined from JOSH1 IMPROVE monitoring data for the 20% best and the 20% worst days for the years 2000 through 2004. The baseline visibility for the Joshua Tree Wilderness Area is calculated at 6.1 deciviews for the 20% best days and 19.6 deciviews for the 20% worst days. Figure 4 represents the worst baseline visibility conditions.

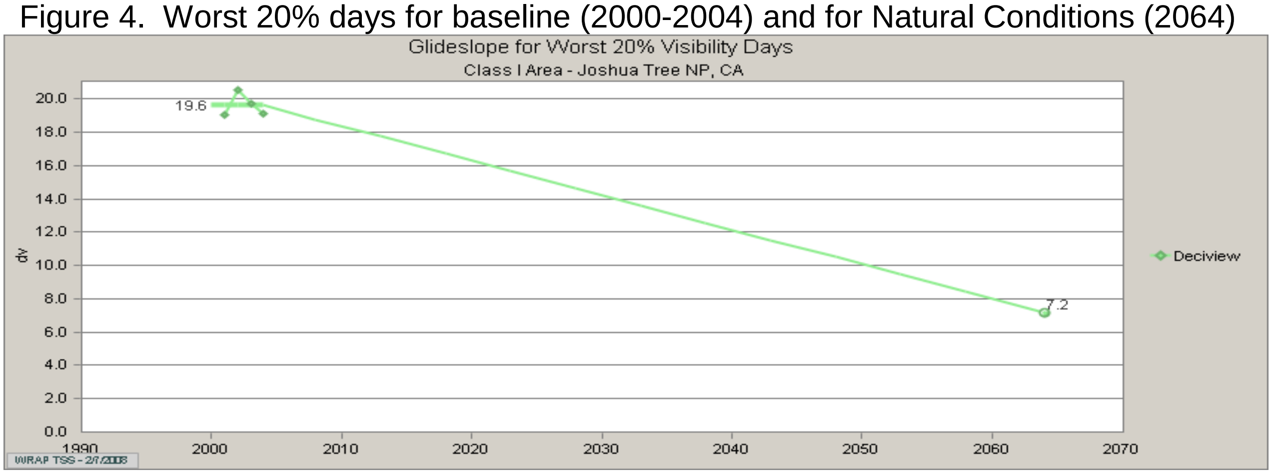
II.c. Natural Visibility

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the natural visibility for the Joshua Tree Wilderness Area is 1.7 deciviews for the 20% best days and 7.2 deciviews for the 20% worst days. It is possible that the Natural Conditions deciview value for 2064 could change in the future as more is learned about natural plant emissions and wildfire impacts.

II.d. Presumptive Glide Slope and the Uniform Rate of Progress

Figure 4 also shows the uniform rate of progress, or "glide slope." The glide slope is the rate of reduction in the 20% worst days deciview average that would have to be achieved to reach natural conditions at a uniform pace in the 60 years following the baseline period. The first benchmark along the path towards achieving natural conditions occurs in 2018. The glide slope shows that the 2018 benchmark for the 20% worst days is 16.72 deciviews. According to the Regional Haze Rule, the 20% best days baseline visibility of 6.1 deciviews must be maintained or improved by 2018, the end of the first planning period.

Figure 4. Worst 20% days for baseline (2000-2004) and for Natural Conditions (2064)



II.e. Species Contribution

Each pollutant species causes light extinction but its contribution differs on best and worst days. Figure 5 shows the contribution of each species to the 20% best and worst days in the baseline years at JOSH1.

Figure 5. Average Haze species contributions to light extinction in the baseline years

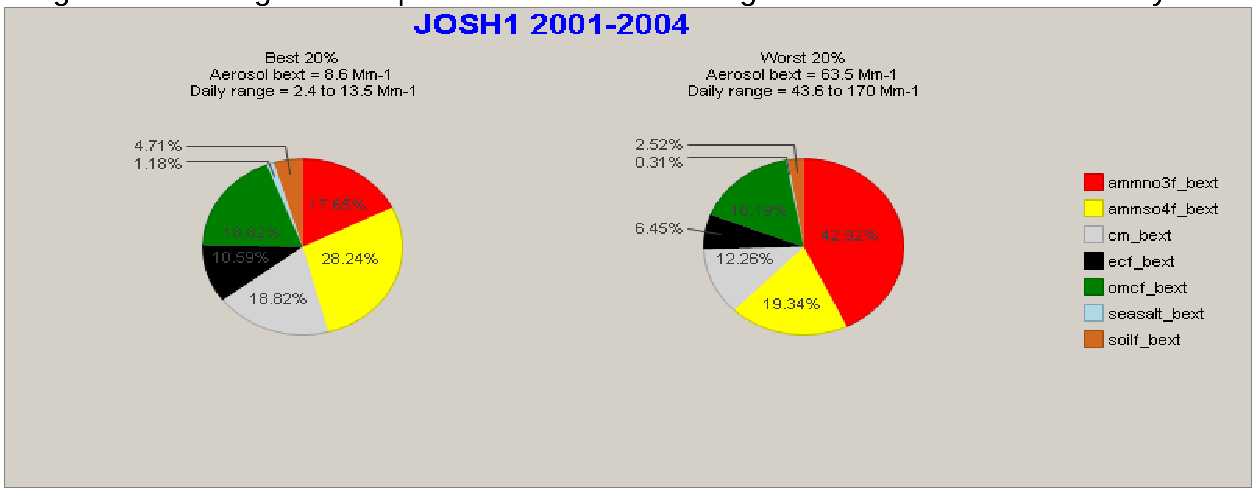
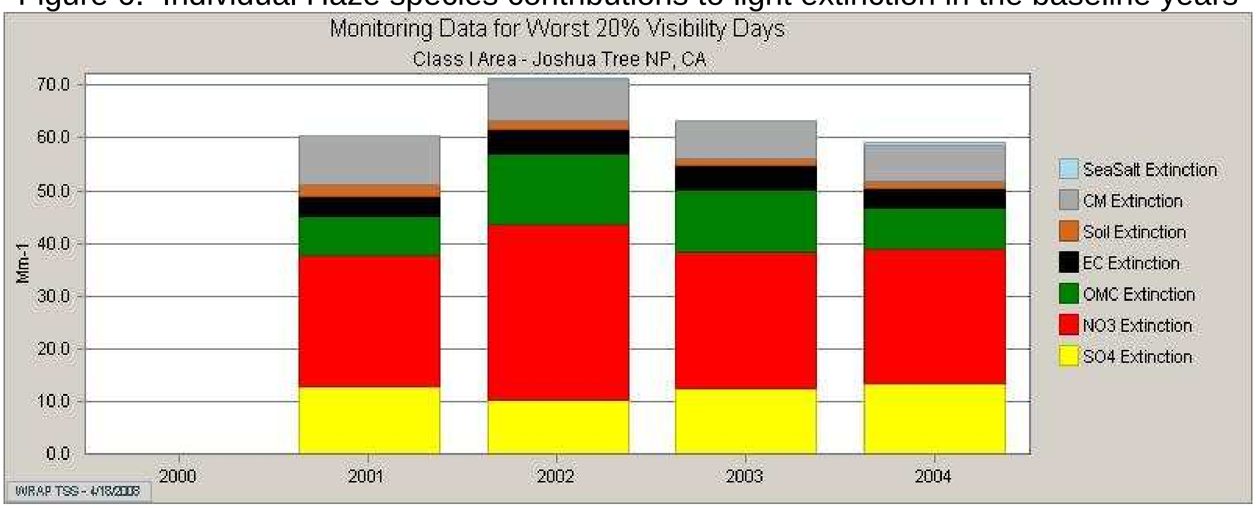


Figure 6. Individual Haze species contributions to light extinction in the baseline years



As shown in Figures 5 and 6, nitrates, sulfates, and organic matter have the strongest contributions to light extinction which degrade visibility on worst days at Joshua Tree National Park. The worst days are dominated by nitrate, while the best days are dominated by sulfate. Data points for 2000 and 2001 were insufficient for calculating best and worst days per the Regional Haze Rule Guidance.

Figure 7 depicts the individual species contribution to worst days in 2002. Nitrates increase in the winter and spring months, while sulfates increase slightly in the summer months. Organic matter increases in the summer. Nitrates clearly dominate the other haze species on worst days, but organic matter, sulfates, coarse mass and elemental carbon also contribute to the worst days. There are only trace amounts of sea salt and soil seen throughout the years.

Figure 8 illustrates the individual species contribution on worst days in 2000-2004 by monthly average. The trend shown is comparable to Figure 7 for nitrates, sulfates, and organic matter. High organic periods vary from year to year due to the unpredictable occurrence of wild fires.

Figure 7. Species contribution on the 20% worst days in 2002

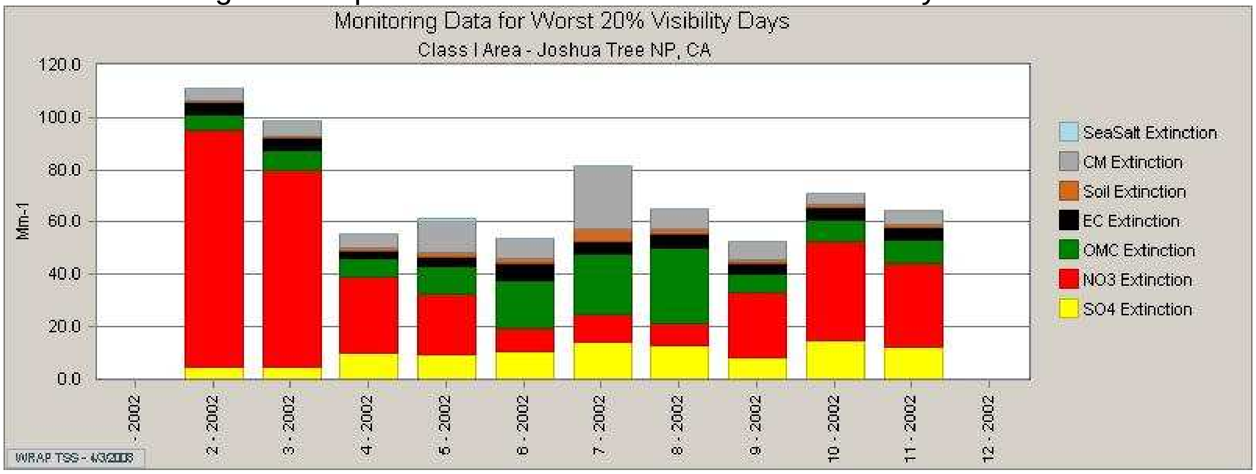
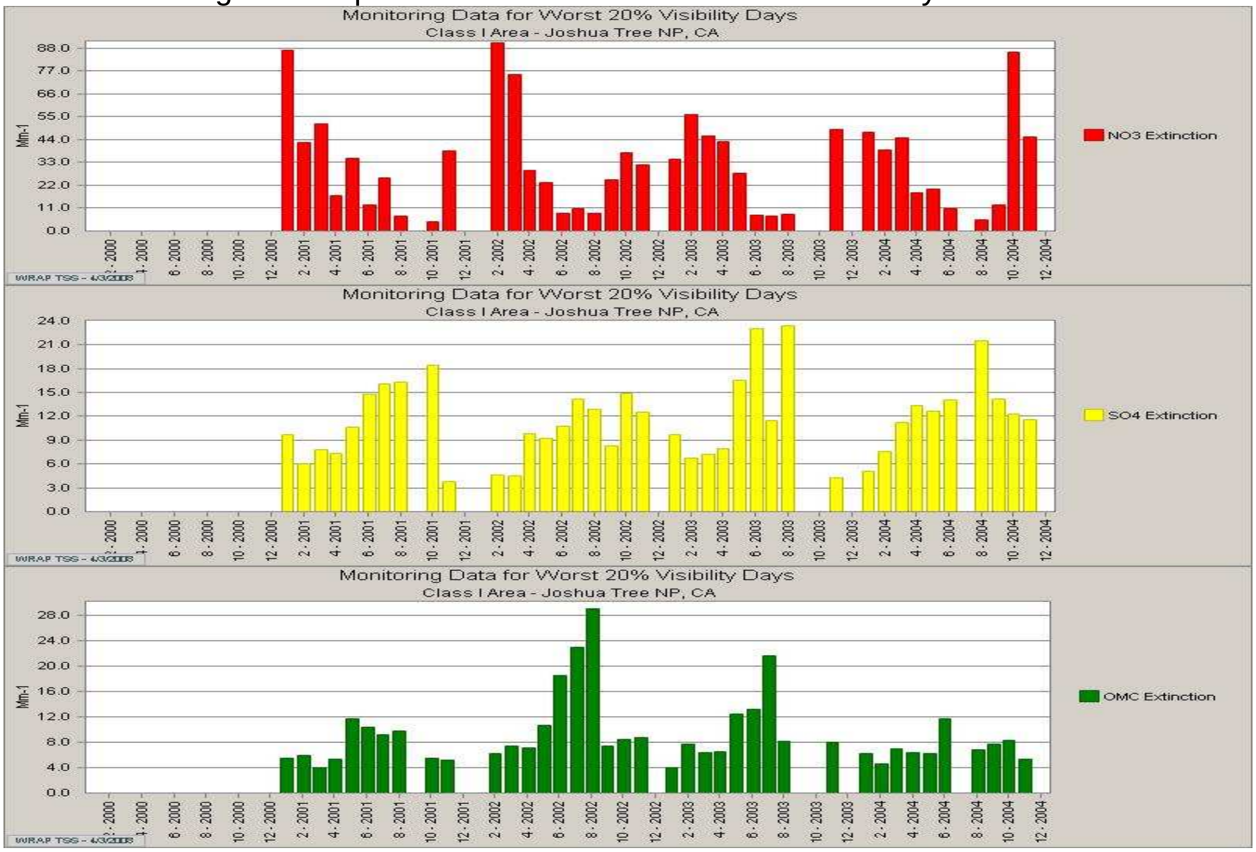


Figure 8. Species contribution on the 20% worst days in 2002



II.f. Sources of Haze Species

Both natural and man-made sources contribute to the calculated deciview levels made by haze pollutants at JOSH1. Some haze species arise from sources that are within the control of the State of California or neighboring states. Others arise from natural, uncontrollable situations such as wildfires, sea salt or dust storms in natural areas, whether they are from in-state or out-of-state (and out-of-country) sources. Finally, other uncontrollable, man-made sources are those industrial pollutants and other man-made (anthropogenic) emissions transported from outside the United States.

Figures 9 and 10 represent the regional contributions to nitrates on the 20% worst days. The WRAP region represents the largest contribution to nitrate in 2002 and 2018 (81%), followed by the Pacific Offshore Region (15%) and emissions from Outside Domain (4%). Mobile sources within California contribute the most nitrate at the JOSH1 monitor. In 2002, 81% of the nitrate at the JOSH1 monitor can be attributed to California. California mobile source emissions reductions are mainly responsible for improvement in nitrates in 2018.

Figures 11 and 12 represent the regional contributions to sulfate on the 20% worst days in 2002 and 2018 at JOSH1. The WRAP region represents 36% of the sulfate contributions in 2002 and 2018, followed by the emissions from the Pacific Offshore Region (30%) and the Outside Domain Region (29%). California contributes 30% of the total sulfate emissions seen at the JOSH1 monitor.

Individually, emissions from outside the modeling domain contribute the most to sulfate concentrations at the JOSH1 monitor. The next largest contributor to sulfate concentrations is area sources in the Pacific Offshore Region.

Figure 13 shows the primary organic carbon source contribution from California and the outside regions. The largest contributor to primary organic carbon at the JOSH1 monitor is from natural fire sources within California. California represents 98% of all natural fire source contributions.

Figure 14 illustrates the total organic carbon source apportionment from 2000-2004 for anthropogenic and biogenic sources. The anthropogenic and biogenic primary source emissions account for 58% of the total organic carbon. Biogenic secondary emissions account for 36% of the total organic carbon emissions and anthropogenic secondary is responsible for the remaining emissions.

Figure 9. Regional Nitrate contribution to Haze in 2002 and 2018

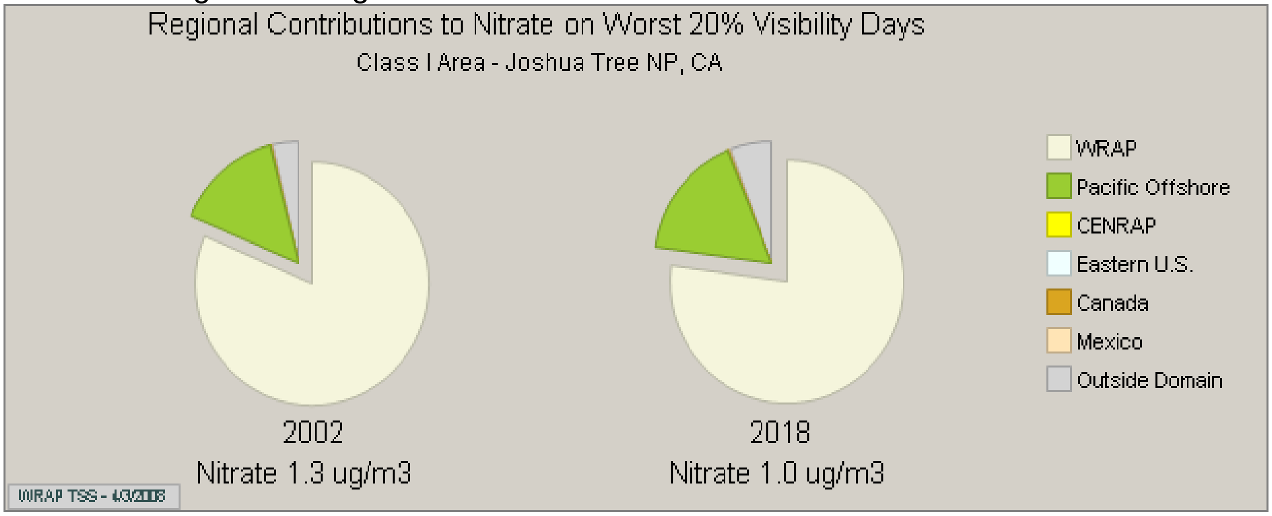


Figure 10. Nitrate source contribution from CA and outside regions

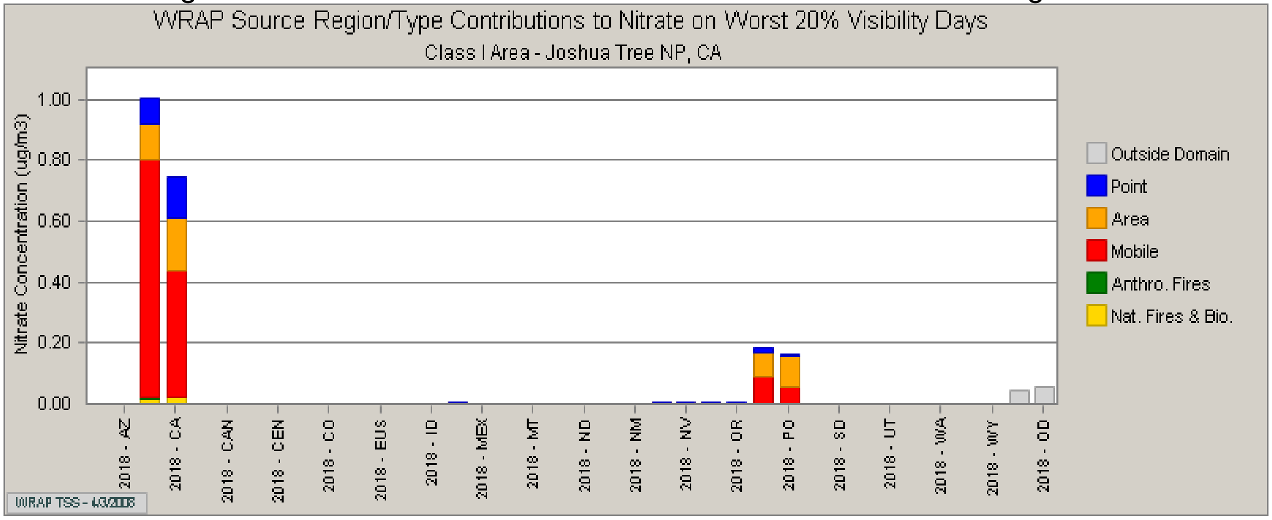


Figure 11. Regional Sulfate contribution to Haze in 2002 and 2018

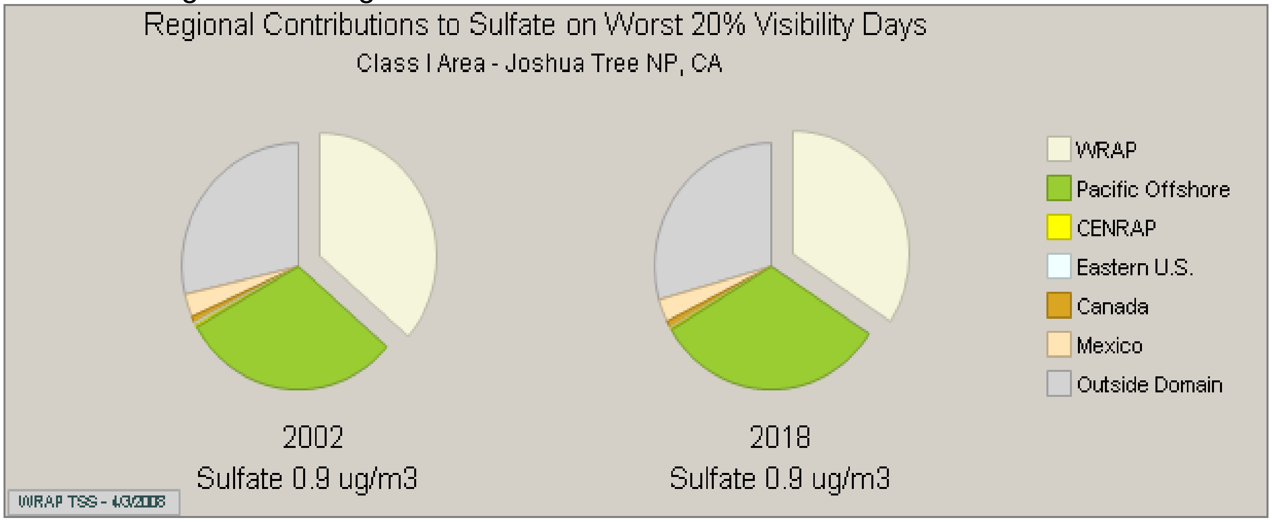


Figure 12. Sulfate source contribution from CA and outside regions

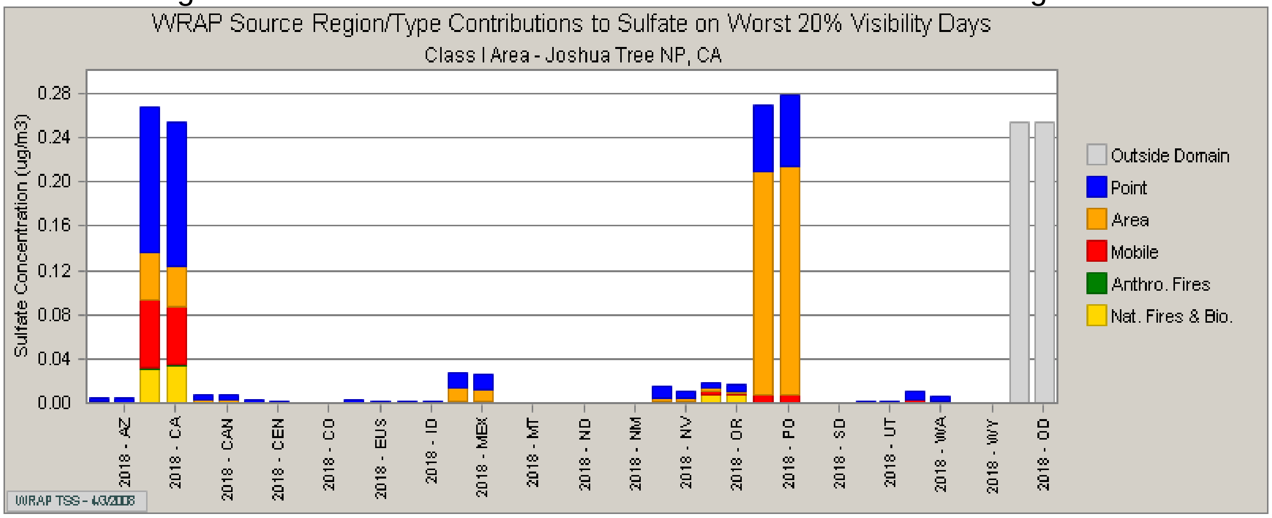


Figure 13. Organic carbon source contribution from CA and outside regions

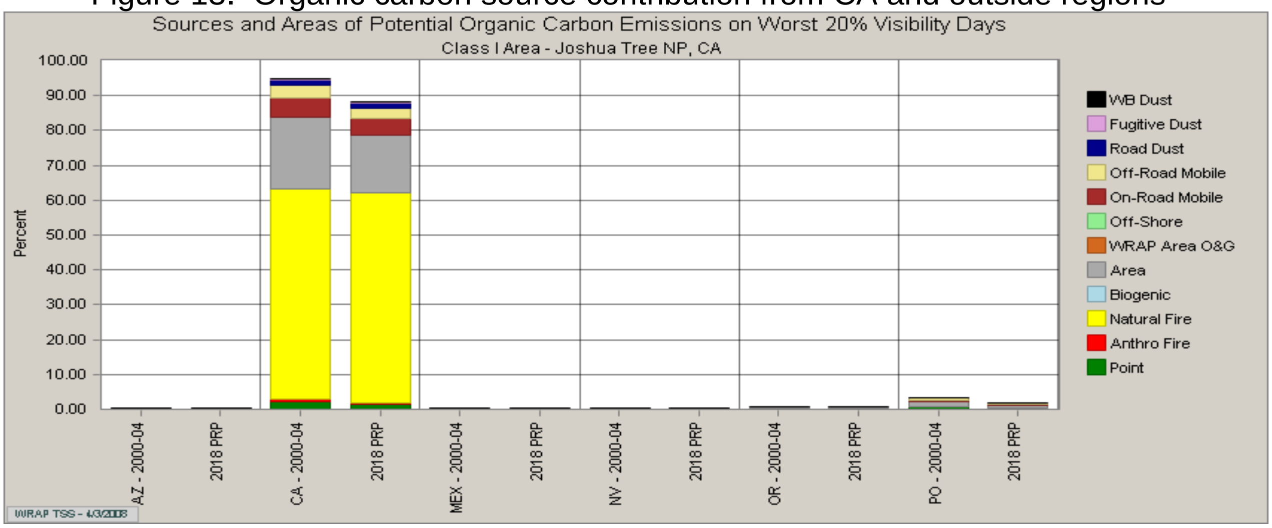


Figure 14. Organic carbon Anthropogenic and Biogenic Source Apportionment